MONTHLY WEATHER REVIEW.

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The Monthly Weather Review summarizes the current manuscript data received from about 3,500 land stations in the United States and about 1,250 ocean vessels; it also gives the general results of the study of daily weather maps based on telegrams or cablegrams from about 200 North American and 40 European, Asiatic, and oceanic stations.

The hearty interest shown by all observers and correspondents is gratefully recognized.

Acknowledgment is also made of the specific cooperation of the following chiefs of independent, local, or governmental services: R. F. Stupart, Esq., Director of the Meteorological Service of the Dominion of Canada; Señor Manuel E. Pastrana, Director of the Central Meteorological and Magnetic Observatory of Mexico; Camilo A. Gonzales, Director-General of Mexican Telegraphs; Capt. I. S. Kimball, General Superintendent of the United States Life-Saving Service; Commandant Francisco S. Chaves, Director of the Meteorological Service of the Azores, Ponta Delgada, St. Michaels, Azores; W. N. Shaw, Esq., Director Meteorological Office, London; Maxwell Hall, Esq., Government Meteorologist, Kingston, Jamaica; Rev. L. Gangoiti, Director of the Meteorological Observatory of Belen College, Havana, Cuba; Luis G. y Carbonell, Director, Meteorological Service of Cuba, Havana, Cuba; Rev. José Algué, S. J., Director of the Weather Bureau, Manila Central Observatory, Philippines; Maj. Gen. M. A. Rykachef, Director of the Physical Central Observatory, St. Petersburg, Russia; Carl Ryder, Director, Danish Meteorological Institute, Copenhagen, Denmark.

As far as practicable the time of the seventy-fifth meridian is used in the text of the Monthly Weather Review.

Barometric pressures, both at land stations and on ocean vessels, whether station pressures or sea-level pressures, are reduced, or assumed to be reduced, to standard gravity, as well as corrected for all instrumental peculiarities, so that they express pressure in the standard international system of measures, namely, by the height of an equivalent column of mercury at 32° Fahrenheit, under the standard force, i. e., apparent gravity at sea level and latitude 45°.

FORECASTS AND WARNINGS.

By Prof. E. B. Garriott, in charge of Forecast Division.

During the first two days of April a barometric depression advanced from the central valleys of the United States over the Canadian Maritime Provinces, attended by general precipitation east of the Rocky Mountains, by snow over northern districts, and by high winds on the Great Lakes and along the middle Atlantic and New England coasts. The passage of this depression over the north Atlantic Ocean was attended by whole gales. It reached Iceland on the 6th, and moved thence over European Russia during the succeeding five days. Following the depression an area of high barometer and a cold wave swept from British America to the Atlantic coast, with zero temperature in Montana on the 1st, freezing temperature to the southern line of Tennessee on the 3d, and frost in the interior of the South Atlantic States on the 4th.

The second barometric disturbance of the month appeared on the north Pacific coast on the 3d and moved rapidly eastward, attended by rain generally in the central valleys and thence to the Atlantic coast. This disturbance inaugurated over the eastern portion of the United States a period of showery weather and mild temperature that was indicated by the general pressure distribution noted under this head for the closing days of March.

The third disturbance of the month appeared over the southwestern portion of the United States on the 5th and drifted slowly eastward over the southern Plateau and Rocky Mountain districts during the succeeding two days, attended by an extensive area of precipitation. By the morning of the 8th an offshoot from this disturbance had reached Lake Huron and the rain area had advanced to the Atlantic coast. At this time a trough of low pressure extended from eastern Ontario to Texas and thence to the middle Plateau, and snow was falling from the Lake region over the Dakotas and also in Wyoming and eastern Colorado. Moving eastward from Lake Huron, with increasing strength, the storm center reached Nova Scotia the morning of the 9th. During the 9th and 10th the main depression, attended by an extensive rain area, with snow over the upper Lakes, covered the eastern half of the country, and an area of high barometer extended from the north Pacific coast over the middle and northern Rocky Mountain and Plateau regions. The center of this depression past eastward over the North Atlantic States and during the night of the 11th the barometer fell to a reported reading of 28.84 inches at Sydney, C. B. I., with strong gales on the northern coasts. The advance of the western high area was attended during the 12th and 13th by fair and cool weather over middle and eastern districts.

In the Asiatic area a rapid fall in the barometer was shown on the 7th and a decided rise in pressure had occurred over continental Europe. The American storm that reached Iceland on the 6th was deflected southeastward over western Europe and apparently reached the Black Sea, or united with a depression that appeared over southern Europe, where the barometer continued low until the 12th.

On the 13th a sharp fall in the barometer occurred over eastern Siberia, and the depression there indicated advanced over the Pacific to Bering Sea by the 15th.

From the 12th to 15th a rain area advanced from the west Gulf States to the lower Missouri and middle Mississippi valleys and thence to the Atlantic coast, the rainfall from the west Gulf districts over the lower Ohio Valley being heavy. The barometric depression that caused this rain was attended on the 15th by high winds on the Great Lakes and middle and north Atlantic coasts, and was followed by a cool wave that carried the line of freezing temperature to Pennsylvania and caused snow in the upper Lake region and the interior of New York and New England.

The southwestern depression that past eastward over the Canadian Maritime Provinces on the 15th was deflected southeastward by the high barometric area that covered Iceland and northwestern Europe, and during the 17th past near and north of the Azores, and united by the 18th with the low barometric area that appeared over southwestern Europe on the 14th.

This depression drifted slowly over the Continent of Europe, where the barometer continued low until about the close of the month. This distribution of pressure caused cold, stormy weather generally over the Continent and the British Isles, with freezing temperature and snow in the more northern countries.

In the meantime pressure had risen to 30.12 inches over the Hawaiian Islands and fallen to 29.48 inches at Nome, Alaska, by the 16th, a period of heavy rains had set in from the Gulf States over the lower Ohio Valley, and drought conditions obtained in the States of the middle Missouri, Red River of the North, and extreme upper Mississippi valleys. On Saturday the 18th the following forecast was issued for the week beginning April 19th that applied to the regions of excessive rains and continued dry weather:

For the States of the Missouri, extreme upper Mississippi, and Red River of the North valleys, where little or no rain has fallen, a season of showery weather will be inaugurated by the middle of the week. In the Gulf States and lower Mississippi Valley the excessive rains of the past week will give way to a period of more settled weather.

Heavy showers set in over the north-central districts referred to the night of Wednesday, April 22, and precipitation continued in that region during the following three or four days. In the south-central States the prolonged period of rain ended on the 21st.

Following an area of high barometer and cool weather that crost the United States from the 17th to 19th, a depression that produced unusually low barometric readings in the central valleys advanced from the Pacific coast to the Lake region, from the 20th to 26th, attended by general rains, by severe local storms in the south-central States, and by high winds over the Great Lakes and in the Middle Atlantic and New England States.

During the week ending the 25th, high barometer over Iceland and persistent low pressure over continental Europe was attended by wintry weather over the British Isles and the middle and northern countries of Europe. After the 23d the European depression apparently shifted westward over the continent and the British Isles and thence southwestward over the Atlantic, where the barometer fell to the remarkable reading of 29.26 inches at Horta, Azores, on the 29th.

During the 24th and 25th an area of high barometer of great magnitude overspread the Pacific coast States. During the succeeding days of the month this high area moved slowly southeastward attended by a cool wave that carried the line of freezing temperature to extreme northern Texas, and thence over the Ohio Valley and northern portions of the Middle Atlantic States. The cool wave was also attended by snow in the States of the Missouri Valley, and thence over the Ohio Valley and interior portions of the Middle Atlantic States, and by frost in the interior of the Gulf and South Atlantic States.

The month closed with a severe storm moving northeastward over the Atlantic seaboard, very low pressure over the Azores, and high pressure over Iceland and Siberia. The abnormal and persistent distribution of pressure shown at this time, with the barometer high in northern and low in southern latitudes, indicated a rather prolonged period of unseasonably cool weather generally over the United States.

The Denver Republican of April 27, 1908, remarks on frost warnings and fruit in that section as follows:

If the fruit crop in Colorado this year is saved it will be due largely to the fact that Mr. Brandenburg, District Forecaster of the Weather Bureau at Denver, foresaw the frost and that he and the Colorado Telephone Company sent warnings into every fruit-growing district.

Perceiving that the temperature would fall and that in all probability killing frosts would occur, 200 warning telegrams were sent to points in Utah, Wyoming, Colorado, and New Mexico, and the Colorado Telephone Company joined in the effort to put fruit growers on guard by telephoning warnings to some 8,000 ranchmen, whose homes are connected with the system.

The fact that 8,000 ranchmen in Colorado and the northern part of New Mexico have telephones, made it practicable to give the warning wide distribution. This reveals a use in the telephone both interesting in itself and creditable to the telephone company.

Warned in time, the owners of orchards were thereby given an opportunity to protect their fruit by building smudge fires at intervals in their orchards, and it seems probable that a good percentage of the crop was saved from destruction where the precaution was adopted. Unfortunately, in some localities, belief that the temperature would not fall very low prevented many of the farmers from smudging, and while the Grand Valley escaped destruction of the crop the night of Saturday, April 25, the freeze of the following night may have caused great damage in consequence of the fact that much of the material with which to build smudge fires was already consumed. In Fremont County the injury to peaches seems to be very severe; but, fortunately, a large part of the apple crop is probably safe.

Frost being caused in part by the radiation of heat, the smudge fires provide protection by checking radiation. This is done by filling the air with smoke, which constitutes an artificial cloud. This smoke cloud produces much the same effect as a natural cloud, and it is a matter of common knowledge that the danger of a killing frost is less when the sky is overcast. The merit of this expedient has been disputed, but it has proved efficacious in so many cases that fruit growers are convinced that it provides protection when the temperature falls but a little below the freezing point.

BOSTON FORECAST DISTRICT.*

[New England.]

Weather conditions were generally seasonable and snowfall was light. All warnings were displayed in good season, and there were no storms without warnings.—*J. W. Smith, District Forecaster.*

NEW ORLEANS FORECAST DISTRICT.*

[Louisiana, Texas, Oklahoma, and Arkansas.]

Two storm periods occurred, the first on the 23d–24th and the second on the 29–30th, when severe local storms occurred. General frost occurred over the northwestern portion of the district on the 30th. Timely warnings were issued for the frost and gales that occurred on the coast.—*I. M. Cline, District Forecaster.*

LOUISVILLE FORECAST DISTRICT.*

[Kentucky and Tennessee.]

Heavy to killing frost occurred from the 2d to the 4th. The last decade of the month was marked by decided contrasts in temperature. The period 20–26th was warm, that from the 27–30th decidedly cold, with frost on the 29th and 30th, and freezing temperature over a large part of Kentucky on the latter date, with heavy wet snow over Kentucky and light snow in northwestern Tennessee. Special warnings issued in connection with the frost and cold weather were of decided benefit.—*F. J. Walz, District Forecaster.*

CHICAGO FORECAST DISTRICT.*

[Indiana, Illinois, Michigan, Wisconsin, Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas, and Montana.]

The month was warm until the last week when low temperatures and frosts were general in nearly all sections. Because of the previous warm weather it was deemed advisable to issue frost warnings to eastern and southern portions of the district and the forecasts were verified. General navigation did not begin until after the middle of the month. Warnings were ordered for the storms that occurred during the last half and advisory messages were sent for the first half of the month, and no wrecks occurred.—*H. J. Cox, Professor and District Forecaster.*

DENVER FORECAST DISTRICT.*

[Wyoming, Colorado, Utah, New Mexico, and Arizona.]

Temperature was higher than usual, except in New Mexico, the excess being notable in the northern half of the district. Precipitation was deficient in northern Utah; also in Wyoming and eastern Colorado, where the drought was becoming serious. Owing to the light snowfall in the mountains, and despite the prevailing high temperatures, the flow of the streams was small. Destructive frosts of the closing week of the month were accurately forecast and the warnings given wide distribution.—*F. H. Brandenburg, District Forecaster.*

SAN FRANCISCO FORECAST DISTRICT.†

[California and Nevada.]

The month was unusually dry. A drought that began early in March continued until the beginning of the third decade of April. With the exception of some showers at the close of March it was one of the longest spring dry spells experienced for many years in California. No frost nor storm warnings were issued.—*A. G. McAdie, Professor and District Forecaster.*

PORTLAND, OREG., FORECAST DISTRICT.†

[Oregon, Washington, and Idaho.]

The month was warmer than usual and precipitation was deficient. Two storms of note crost the district, one on the 17th and the other on the 24th. Warnings for these storms were timely and no casualties of consequence are known to have occurred. Frosts were frequent and all important frosts were forecast sufficiently in advance for the warnings to be of benefit.—*E. A. Beals, District Forecaster.*

RIVERS AND FLOODS.

The rivers of the northern portion of the country showed, as a rule, very little departure from their usual gage readings. The breaking of a dam on the upper Missouri River, 15 miles north of Helena, Mont., caused considerable local damage and for a time threatened serious loss, but the removal of obstructions and a dam by dynamite relieved the situtation and the water subsided without serious damage, excepting the loss of two lives, one of which occurred when the dam was blown up.

During the last of March and the first of April excessive rains fell over the mountains of West Virginia and Kentucky, causing rapid and destructive rises of all the southern tributaries of the Ohio River below Parkersburg, W. Va. These, flowing into the already well-filled Ohio, caused a rapid rise of that stream, and flood stages were past at all points from Point Pleasant, W. Va., to Cairo, Ill.; the flood stage being exceeded at Cincinnati by 5.9 feet and at Cairo by 0.3 of a foot. This was the fourth and also the greatest flood this year. It also is of interest to note that, when the Ohio fell below the former flood stage of 40 feet at Cairo, Ill., on the 22d, with the exception of four days, the water had been above this mark since February 18.

Very little damage has been reported, except the loss of growing crops, owing to the timely and accurate warnings that were issued.

Heavy rains also fell over the lower portion of the Mississippi Valley, and as a result all the tributaries of the lower Mississippi River were high and several times exceeded the flood mark and overflowed the bottoms, causing some loss to live stock and to early planting, especially along the Red, Arkansas, and White rivers. These floods, combined with the heavy rains and the passage of the flood waters of the Ohio River, caused the Mississippi River to exceed flood stages thruout its length from the Ohio River to the mouth, in fact, the mean stages of the river below Memphis, Tenn., to New Orleans, La., for the month, were above the flood mark, and at several places the lowest reading for the month was above the flood line. Ample and timely warnings were issued for this high water by all the districts and very little damage has been reported. The breaking of one or two levees was reported, and by quick work the crevass was closed before much damage had occurred.

The rivers of the South Atlantic States did not exceed flood-stage mark during the month, altho some high water was reported.

The Trinity, Brazos, and Colorado rivers of Texas were all in flood, caused by the heavy rains during the last of the month, and considerable damage was done, especially along their upper portions, where the water rose higher than it has for several years.

The rivers of the Pacific coast were, as a rule, quiet, and were highest during the last days of the month.

The highest and lowest water, mean stage, and monthly range at 214 river stations are given in Table IV. Hydrographs for typical points on seven principal rivers are shown on Chart I. The stations selected for charting are Keokuk, St. Louis, Memphis, Vicksburg, and New Orleans, on the Mississippi; Cincinnati and Cairo, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock, on the Arkansas; and Shreveport, on the Red.—*Hermann E. Hobbs.*

* Morning forecasts made at district center; night forecasts made at Washington, D. C.

† Morning and night forecasts made at district center.

SPECIAL ARTICLES, NOTES, AND EXTRACTS.

CHINOOK WINDS IN EASTERN COLORADO DURING DECEMBER, 1907.

By L. H. DAINGERFIELD, Local Forecaster. Dated Pueblo, Colo., April 22, 1908.

The following text, with the accompanying daily maps and thermograms, see Charts IX and X, illustrates the chinook conditions prevailing over eastern Colorado during the closing week of December, 1907. Mountain time is used in both the text and the diagrams.

December 22.—Unusually well-developed chinook conditions prevailed over eastern Colorado during the closing week of December, 1907. During this week the pressure was relatively high almost continuously from the region where the Continental Divide crosses Colorado and New Mexico to California. A series of storms moved with great regularity from British Columbia southeastward over Montana and the Dakotas, eastward across the Lake region, and down the St. Lawrence Valley to the coast. Such was the condition on the morning of December 22, 1907, when a great indraft of air was being drawn eastward from over the mountains as is evidenced by the brisk westerly wind which prevailed at Pueblo at intervals between 1 p. m. of the 22d and 5 a. m. of the 23d, the maximum being 37 miles per hour from the west at 10:49 p. m. A glance at the accompanying thermograph trace will show a harmonious temperature response to the strong draft from over the mountains.

December 23.—The forenoon of December 23 shows a continuation of the foehn conditions of the preceding day, being augmented, as is frequently the case, by a small secondary depression over eastern Colorado. The temperature on this date exhibits remarkable variation between 1 and 9 a. m., during which time Pueblo was undoubtedly under the influence of the local depression. In Colorado the moderate precipitation on the western slope of the mountains possibly influenced the eastern slope temperature to some extent.

December 24.—A well-developed storm covered the Dakotas and eastern Montana on the morning of December 24, and the pressure remained moderately high over the Southwest and also over the California coast. Brisk to high westerly to northwesterly winds resulted at Pueblo between 10 a. m. and 6 p. m., reaching the velocity of a gale at 12:45 p. m., when a movement of 45 miles per hour from the northwest was recorded. This strong indraft from over the range of mountains was attended locally by a maximum temperature of 63° which coincided in time with that of the occurrence of the maximum wind velocity.

December 25.—A high-pressure area developed over the eastern slope by the morning of December 25 which destroyed the persistent chinook condition, but another depression had appeared over British Columbia.

December 26.—The British Columbia disturbance was central

TABLE 1.—*Climatological data for Kansas*—Continued.

Month and year.	Temperature (in ° F.).										Precipitation (in inches).									
	Average.				Maximum.			Minimum.			Average.				Maximum.			Minimum.		
	Eastern division.	Middle division.	Western division.	State.	Eastern division.	Middle division.	Western division.	Eastern division.	Middle division.	Western division.	Eastern division.	Middle division.	Western division.	State.	Eastern. division.	Middle division.	Western division.	Eastern division.	Middle division.	Western division.
May.																				
1887	69.5	71.2	67.6	69.5	98	98	95	35	30	34	2.81	1.85	2.64	2.56	6.42	2.91	3.69	1.12	1.04	1.48
1888	62.6	63.1	59.3	61.7	91	94	105	30	33	44	3.50	3.20	3.03	3.24	6.63	5.00	6.94	0.87	2.02	1.22
1889	62.7	64.4	61.7	62.9	94	100	100	30	29	25	7.35	5.99	3.13	5.48	12.14	11.60	7.00	4.50	1.65	0.59
1890	63.9	64.5	64.9	64.4	98	97	106	30	25	28	3.63	1.83	0.99	2.08	6.84	5.18	2.96	1.24	0.31	T.
1891	62.1	62.0	62.3	62.1	92	95	96	30	27	29	4.97	5.39	3.99	4.78	7.31	10.25	7.90	2.54	2.70	1.50
1892	60.3	59.4	55.7	58.5	94	96	96	35	28	27	8.72	6.60	5.27	6.99	14.10	13.50	8.40	5.15	3.78	2.30
1893	62.1	62.4	60.0	61.5	92	99	103	31	23	17	5.22	2.44	1.45	3.04	7.62	5.64	3.45	3.05	0.92	0.40
1894	65.6	64.9	65.2	65.2	96	100	102	30	20	25	2.72	2.17	1.72	2.20	4.41	4.58	5.16	0.41	0.50	T.
1895	66.7	66.9	63.8	65.8	103	106	106	27	28	26	3.35	1.46	2.89	2.57	6.66	4.00	6.10	1.10	0.39	0.78
1896	70.1	70.2	66.4	69.3	97	107	106	40	31	30	7.53	4.14	1.81	4.75	12.67	12.01	4.47	1.75	1.27	T.
1897	64.5	63.8	63.6	64.1	98	96	96	33	30	30	2.26	2.35	1.82	2.04	4.84	5.02	3.77	0.60	0.49	0.01
1898	64.6	63.7	60.3	62.9	93	95	95	33	31	29	7.28	5.86	5.70	6.28	11.88	11.20	10.31	3.46	2.62	3.61
1899	67.6	68.0	66.0	67.4	93	104	105	32	29	24	4.25	4.22	1.69	3.68	7.37	8.43	4.89	0.80	0.26	0.40
1900	66.5	65.4	63.6	65.5	94	94	95	38	32	29	4.31	3.81	1.41	3.39	6.67	6.50	3.37	2.58	1.08	0.20
1901	63.9	63.1	61.8	63.1	92	91	95	30	30	25	1.73	1.75	1.37	1.64	4.12	3.11	2.45	0.44	0.18	0.42
1902	69.6	68.5	66.4	68.4	95	101	100	39	37	35	7.73	6.92	4.60	6.64	11.40	10.88	10.00	4.08	3.39	2.37
1903	63.8	62.1	60.0	62.4	89	91	92	20	23	29	10.23	9.71	3.84	8.57	16.34	17.34	7.45	6.96	5.53	1.49
1904	62.9	62.3	61.8	62.4	92	94	94	33	21	28	7.21	5.74	3.35	5.81	11.71	8.28	4.59	3.28	2.28	1.28
1905	64.7	63.3	60.1	63.1	92	95	92	33	32	29	5.68	4.01	3.57	4.54	8.98	6.79	8.11	3.30	2.10	1.37
1906	66.4	64.6	63.4	65.0	99	97	97	27	25	30	3.23	2.56	1.69	2.62	7.32	2.66	2.10	0.72	0.70	0.65
Averages and extremes for 20 years	65.0	64.7	62.7	64.3	103	107	106	20	20	17	5.19	4.10	2.78	4.14	16.34	17.34	10.31	0.41	0.18	T.
June.																				
1887	76.2	76.8	76.3	76.2	102	104	102	45	44	52	4.69	3.59	2.47	3.58	9.63	7.60	4.12	2.12	1.27	0.80
1888	75.1	75.2	73.6	74.6	103	102	105	42	38	44	5.44	3.04	2.04	3.96	9.14	5.69	5.16	3.91	1.53	0.50
1889	71.0	72.3	70.0	71.2	99	98	105	41	42	40	4.69	3.90	3.35	4.01	8.85	7.89	10.03	1.44	1.15	0.49
1890	77.2	77.8	77.7	77.6	106	107	106	39	42	33	2.69	3.66	1.76	2.65	4.73	9.02	4.71	1.26	0.48	0.20
1891	72.0	70.8	69.4	70.7	96	100	100	46	46	37	8.67	4.92	5.24	6.28	14.70	7.40	10.84	4.25	2.93	2.32
1892	74.7	74.0	71.4	73.4	104	104	109	43	33	33	2.18	1.86	1.58	1.87	4.57	4.67	3.34	0.26	0.43	0.23
1893	73.6	75.2	75.3	74.7	102	112	114	46	42	35	5.48	4.26	2.00	3.91	13.10	9.80	4.04	2.21	0.87	0.76
1894	74.9	74.6	73.2	74.2	105	108	110	41	31	34	5.85	6.31	2.67	4.94	11.00	14.98	4.93	1.90	2.01	1.31
1895	74.2	73.2	69.7	71.7	105	108	105	44	44	34	5.06	5.10	4.87	5.01	8.85	7.00	9.00	2.41	1.86	2.73
1896	73.6	74.6	74.1	74.1	105	110	114	43	41	39	3.44	5.71	3.51	4.32	7.84	9.97	6.41	1.30	1.97	0.86
1897	75.5	76.2	73.7	76.6	105	111	113	39	38	38	5.45	2.90	2.57	3.64	11.01	6.82	5.00	2.98	0.27	0.25
1898	76.0	75.5	73.7	75.0	101	104	108	52	49	40	5.09	4.46	3.64	4.60	9.96	8.07	3.86	2.65	1.77	0.65
1899	74.2	73.5	73.5	73.9	97	110	110	43	44	40	5.15	7.21	3.76	5.53	8.30	11.10	11.17	1.50	4.03	0.58
1900	74.7	75.4	74.5	74.9	107	108	110	46	46	43	4.85	2.78	3.14	3.68	10.30	6.20	7.55	0.96	0.55	1.26
1901	77.7	77.6	76.1	77.3	107	108	107	40	41	37	2.40	2.83	1.60	2.35	4.82	6.50	2.63	0.36	0.88	0.30
1902	71.0	71.2	70.5	70.9	100	104	106	36	34	34	7.37	6.52	3.51	6.64	12.45	11.66	6.53	3.49	2.50	0.48
1903	68.1	67.2	65.6	67.2	101	102	103	40	38	33	2.65	2.07	2.42	2.40	4.91	4.40	7.10	0.57	0.38	0.96
1904	71.2	70.5	68.9	70.4	98	100	99	47	42	35	8.80	6.75	4.17	7.04	16.07	13.22	7.11	3.47	2.71	2.02
1905	76.1	75.6	74.2	75.5	100	108	105	48	47	42	3.55	5.13	2.56	3.96	7.79	13.64	4.97	1.60	1.85	0.57
1906	72.7	71.9	69.9	71.8	100	103	108	41	39	37	5.56	2.64	2.81	3.83	11.42	6.00	4.73	2.07	1.12	1.32
Averages and extremes for 20 years	74.0	74.0	72.6	73.6	107	112	114	36	31	33	4.95	4.28	2.98	4.18	16.07	14.98	11.17	0.26	0.27	0.20
July.																				
1887	80.1	84.5	82.1	80.1	108	105	106	52	56	57	1.79	1.78	2.49	2.02	3.00	4.08	4.05	1.06	0.20	0.78
1888	80.5	81.6	79.5	81.2	108	108	110	58	50	32	2.53	2.25	3.14	2.64	7.00	4.85	6.75	0.77	0.30	0.75
1889	76.2	77.5	77.0	76.9	103	106	108	50	47	41	6.20	4.97	2.77	4.65	10.28	11.75	7.59	3.02	2.25	0.20
1890	82.1	83.9	83.4	83.1	108	113	110	52	50	45	1.97	0.47	1.45	1.28	4.13	1.33	4.50	0.00	0.00	0.20
1891	73.8	73.8	74.3	74.0	99	104	104	47	49	44	3.64	5.81	4.23	4.56	8.06	11.93	6.70	1.15	3.46	1.25
1892	77.2	78.2	77.0	77.5	108	108	109	49	47	41	4.09	3.29	2.63	3.34	6.47	6.51	6.40	1.74	0.72	0.65
1893	79.1	80.3	79.1	79.5	107	110	113	57	42	42	3.98	3.31	3.28	3.52	6.92	6.71	9.28	0.37	0.86	0.69
1894	77.2	78.2	78.0	77.8	115	114	116	45	48	42	1.83	1.43	1.61	1.62	4.93	5.08	4.95	0.15	T.	0.35
1895	75.8	76.0	73.0	74.9	108	110	105	48	44	42	6.45	4.10	5.98	5.53	12.17	8.63	12.31	2.40	0.96	2.99
1896	78.3	78.7	77.3	78.1	107	108	108	51	52	48	5.75	5.33	2.74	4.75	8.66	10.95	5.41	3.33	1.64	0.83
1897	80.1	81.2	79.4	80.2	106	109	111	49	50	45	3.36	2.63	3.39	3.13	7.03	7.13	4.77	0.70	0.05	1.45
1898	77.2	78.4	77.5	77.7	102	108	110	50	48	46	3.31	2.72	2.98	3.00	6.80	5.30	6.07	0.80	0.98	0.82
1899	76.3	76.7	75.2	76.2	98	102	106	45	51	49	6.86	3.74	5.55	5.32	11.44	5.84	9.75	4.39	1.21	2.52
1900	77.3	78.8	77.3	77.9	102	104	106	52	48	43	4.69	2.98	2.25	3.46	7.86	11.59	4.95	2.55	1.05	1.29
1901	85.9	85.9	82.6	85.0	111	112	109	52	50	44	2.49	1.49	1.55	1.89	4.82	4.85	3.88	0.70	0.15	0.15
1902	77.0	77.1	76.4	76.8	102	101	105	48	48	45	5.33	3.95	3.32	4.32	9.75	9.80	7.09	1.80	1.14	0.45
1903	78.2	78.8	77.8	78.3	104	110	108	48	46	44	3.90	2.85	2.32	3.17	10.41	6.07	5.59	1.09	0.45	T.
1904	75.5	75.8	75.5	75.6	101	101	103	49	46	49	7.92	6.38	3.60	6.41	12.93	12.03	6.99	3.92	1.83	1.71
1905	74.5	75.1	73.3	74.5	103	108	105	46	44	34	5.99	5.59	4.76	5.55	11.45	10.45	8.46	2.26	2.05	0.86
1906	74.5	73.8	72.5	73.8	97	100	102	50	45	42	4.97	4.41	4.46	4.65	9.46	8.98	7.91	2.56	2.09	1.71
Averages and extremes for 20 years	77.8	78.7	77.4	78.0	115	114	116	45	42	32	4.35	3.47	3.22	3.74	12.93	12.03	12.31	0.00	0.00	T
August.																				
1887	76.5	77.8	74.6	75.3	111	106	108	46	50	47	4.29	5.95	4.03	4.34	7.11	9.83	8.50	2.45	2.50	1.90
1888	75.6	77.8	72.7	76.3	100	107	105	49	42	48	5.69	3.96	3.51	4.39	9.23	7.77	10.00	3.58	1.20	0.30
1889	73.9	75.8	78.6	76.1	100	100	103	48	45	42	3.41	2.50	2.60	2.84	8.38	4.90	4.24	0.37	T.	0.75
1890	75.6	76.3	76.3	76.1	109	109	108	50	46	41	6.19	4.41	1.87	4.06	11.00	10.80	3.45	2.26	0.64	0.10
1891	74.9	74.7	75.6	75.1	105	108	106	36	37	39	1.56	1.17	1.08	1.27	6.50	3.00	2.46	T.	0.30	0.30
1892	76.5	77.1	75.9	76.5	108	107	111	46	36	42	3.73	3.27	3.30	3.43	5.59	7.76	6.96	1.55	0.65	0.15
1893	74.1	74.8	72.9	73.8	111	104	110	41	41	38	2.59	3.19	2.30	2.69	6.40	7.10	4.33	0.23	0.73	0.96
1894	78.9	79.0	76.0	78.0	111	112	107	40	43	41	0.80	0.49	0.71	0.67	2.51	1.61	1.83	T.	T.	0.00
1895	76.1	76.8	75.0	76.0	110	106	107	52	42	47	8.24	5.45	1.90	5.20	12.45	8.46	3.65	3.33	2.49	0.00
1896	78.4	79.5	77.9	78.7	110	112	115	48	42	43	3.62	2.15	2.29	2.69	8.56	7.98	4.15	0.10	0.07	0.22
1897	76.0	77.0	75.4	76.0	107	109	108	46	46	43	2.73	2.72	3.72	3.06	4.01	6.30	6.30	0.87	0.56	1.75
1898	77.1	78.9	78.5	78.2	104	108	108	46	47	48	2.44	2.87	1.58	2.46	6.30	5.68	3.20	0.80	0.71	0.00
1899	80.1	81.6	79.9	80.6	106	109	109	52	50	42	2.64	2.07	1.07	2.09	6.39	3.21	3.05	0.28	0.62	0.19
1900	80.5	82.1	80.0	81.0	108	110	110	51	49	47	2.78	2.12	1.36	2.25	9.05	4.68	3.52	0.29	0.22	T.
1901	79.1	80.1	77.7	79.1	109	109	110	52	52	49	2.72	2.02	3.20	2.61	4.52	5.67	5.31	1.49	0.71	0.71
1902	77.4	78.5	78.7	78.2	106	109	112	42	42	40	8.13	5.45	2.87	5.89	14.36	10.19	6.29	3.72	2.22	0.34
1903	74.8	75.8	75.5	75.3	104	105	105	45	43	39	6.82	4.78	2.95	5.19	12.69	7.53	9.05	3.79	1.17	0.73
1904	74.5	74.6	74.7	74.6	102	103	104	42	38	39	3.94	2.98	2.96	3.35	9.27	6.25	5.85	1.72	1.06	1.32
1905	78.6	79.1	78.3	78.7	107	107	112	53	47	47	3.03	1.22	1.06	1.88	6.74	3.25	2.46	0.93	0.04	0.25
1906	76.6	76.6	75.5	76.3	100	103	105	42	36	41	4.87	4.11	2.49	3.98	10.91	9.22	4.42	2.42	T.	0.10
Averages and extremes for 20 years	76.8	77.7	76.5	77.0	111	112	115	36	36	38	4.04	3.15	2.34	3.21	14.36	10.80	10.00	T.	T.	0.00

TABLE 1.—*Climatological data for Kansas*—Continued.

Month and year.	Temperature (in ° F.).										Precipitation (in inches).									
	Mean.				Maximum.			Minimum.			Average.				Greatest.			Least.		
	Eastern division.	Middle division.	Western division.	State.	Eastern division.	Middle division.	Western division.	Eastern division.	Middle division.	Western division.	Eastern division.	Middle division.	Western division.	State.	Eastern division.	Middle division.	Western division.	Eastern division.	Middle division.	Western division.
September.																				
1887	68.7	70.6	68.2	68.7	99	102	101	32	40	32	3.89	3.42	1.64	2.76	5.73	5.22	4.30	1.65	0.80	0.14
1888	65.9	70.1	66.6	67.9	100	98	98	33	38	32	1.14	0.72	0.36	0.72	3.91	2.78	1.50	0.23	0.00	0.00
1889	64.0	66.2	67.5	65.9	101	97	100	30	30	28	3.70	1.46	0.53	1.90	10.59	5.85	1.71	0.88	0.00	0.00
1890	64.3	65.8	66.1	65.4	98	104	104	29	27	29	3.53	1.55	0.90	1.84	6.62	3.25	2.20	0.88	0.20	0.20
1891	71.6	69.9	70.2	70.6	107	105	102	31	34	33	0.99	2.71	3.77	2.49	2.30	9.00	8.60	0.15	0.72	1.40
1892	69.7	71.2	68.5	69.8	97	99	103	36	37	30	1.50	1.19	0.41	1.03	4.05	3.99	1.50	0.36	0.28	T.
1893	71.5	71.5	67.6	70.5	110	109	105	34	32	29	3.51	2.30	1.69	2.50	5.99	3.73	2.93	0.77	1.32	0.73
1894	69.4	69.4	66.7	68.5	100	104	107	32	26	30	5.44	3.80	1.62	3.62	9.44	9.72	3.84	2.70	0.86	0.25
1895	73.3	73.9	70.9	72.7	105	110	107	27	20	22	3.85	0.72	0.60	1.71	10.12	2.13	2.58	0.73	T.	0.00
1896	66.1	66.7	64.8	65.8	101	108	106	32	29	28	3.91	3.40	1.67	2.99	6.88	6.44	4.15	1.90	1.12	0.77
1897	75.2	74.3	72.6	74.0	105	104	103	36	40	39	1.25	1.33	1.48	1.35	2.75	2.80	3.42	0.05	0.45	0.08
1898	71.3	70.5	66.3	69.4	102	106	108	36	30	28	5.09	2.94	3.51	3.85	9.39	5.40	6.53	1.96	0.91	1.10
1899	68.1	69.3	68.9	68.8	103	108	107	25	25	31	1.75	2.55	1.32	1.91	4.10	4.75	3.02	0.55	0.00	0.25
1900	71.2	70.7	68.0	70.4	108	104	101	39	35	29	8.08	5.91	3.23	6.37	14.35	8.78	7.15	3.93	2.98	0.78
1901	69.2	69.8	67.5	69.1	100	99	98	30	30	29	3.54	2.75	2.97	3.12	6.02	5.07	9.74	1.17	0.50	0.22
1902	63.1	64.0	64.6	63.8	89	95	102	29	29	24	4.64	3.43	2.26	3.62	6.56	7.02	8.57	2.93	1.55	0.25
1903	66.9	67.3	66.1	66.8	98	100	101	32	29	21	3.61	1.86	0.40	2.25	7.69	5.28	0.83	1.12	0.05	0.08
1904	70.9	70.2	68.9	70.2	101	103	103	34	30	25	2.95	2.38	2.37	2.60	5.01	5.14	5.39	0.64	0.73	1.26
1905	71.2	71.9	70.7	71.4	107	105	100	37	39	35	7.92	3.94	1.90	5.06	11.76	8.18	5.11	4.00	1.19	0.38
1906	72.2	69.9	67.8	70.4	100	100	99	36	31	28	3.75	4.71	2.55	3.81	8.18	10.20	9.26	1.26	1.90	0.50
Averages and extremes for 20 years	69.2	69.7	67.9	69.0	110	110	108	25	20	21	3.70	2.65	1.76	2.78	14.35	10.20	9.74	0.05	0.00	0.00
October.																				
1887	54.2	56.0	53.5	54.6	92	96	94	20	17	10	2.88	1.14	1.02	1.40	4.81	2.05	3.00	0.63	0.50	0.35
1888	53.8	54.0	52.6	55.6	91	89	87	18	22	21	2.47	0.68	1.47	1.53	4.25	3.14	2.20	1.96	0.12	0.81
1889	54.6	56.0	55.7	55.4	96	98	98	26	24	20	1.84	2.88	2.39	2.37	2.75	5.77	4.46	0.94	0.00	0.05
1890	55.7	55.4	54.0	55.0	91	89	88	19	22	21	3.54	1.09	0.68	1.77	6.98	3.85	2.29	0.50	0.00	0.05
1891	56.3	54.9	53.1	54.8	99	98	89	22	24	22	1.28	3.79	1.32	1.89	3.01	7.50	4.50	0.30	0.78	T.
1892	57.9	58.2	55.0	54.9	93	97	99	20	21	21	3.19	2.05	0.61	1.94	6.94	4.36	2.55	0.90	0.20	T.
1893	57.7	54.6	52.9	55.1	95	97	95	22	18	21	0.43	0.21	0.22	0.29	1.82	0.84	0.77	T.	0.00	0.00
1894	58.4	59.2	56.1	57.9	93	94	97	22	17	14	2.07	1.32	0.25	1.21	4.33	2.80	1.90	0.59	0.30	0.00
1895	53.2	53.0	50.7	52.3	93	86	87	16	12	11	0.30	1.09	0.72	0.70	0.53	2.15	1.83	0.00	0.41	T.
1896	55.2	54.6	52.6	54.2	94	95	93	24	24	12	3.51	3.13	1.74	2.79	5.13	5.62	3.18	1.45	1.64	0.55
1897	63.3	61.5	57.7	60.9	97	94	97	29	26	22	1.41	2.68	3.38	2.39	2.67	5.80	5.50	0.54	0.70	1.39
1898	54.1	54.6	51.7	53.8	96	100	99	21	17	15	2.84	1.47	0.92	1.92	4.40	2.68	1.87	1.52	0.27	0.26
1899	63.5	62.3	57.0	61.8	96	94	96	27	25	18	1.66	2.51	0.71	1.75	4.67	6.04	3.94	0.50	0.26	0.00
1900	62.4	61.5	59.2	61.5	93	94	97	28	26	22	3.47	2.98	0.53	2.68	5.59	5.71	1.38	1.71	1.23	0.03
1901	61.5	60.5	57.2	60.0	97	94	92	26	24	21	1.94	2.60	0.97	1.89	3.32	6.30	2.34	0.56	T.	0.00
1902	59.7	58.8	57.1	58.8	88	94	90	26	22	20	2.22	2.26	2.13	2.21	3.72	4.00	2.93	0.82	1.23	1.55
1903	57.4	57.6	56.2	57.2	89	92	93	21	23	17	4.74	4.16	0.98	3.63	8.02	7.93	2.87	2.05	1.95	0.16
1904	59.4	59.5	57.5	59.0	95	96	95	21	19	13	0.99	1.13	1.59	1.18	3.58	2.77	3.65	0.13	0.10	0.37
1905	54.8	54.2	48.7	54.0	93	93	92	16	16	8	3.10	1.27	0.67	1.88	7.68	2.12	1.05	1.23	0.45	0.06
1906	56.2	54.1	52.5	54.6	93	93	94	20	18	17	0.79	2.51	2.68	1.89	2.38	4.01	5.11	0.23	0.69	1.57
Averages and extremes for 20 years	57.5	57.0	54.6	56.6	99	100	99	16	12	8	2.23	2.05	1.25	1.87	8.02	7.93	5.50	0.00	0.00	0.00
November.																				
1887	43.7	42.9	40.4	41.5	87	85	90	-20	-16	-20	0.83	0.21	0.39	0.90	1.40	0.50	0.67	0.20	T.	T
1888	39.6	40.1	35.3	38.1	86	85	80	6	9	8	1.73	0.18	0.20	0.67	4.54	1.75	0.50	0.96	0.00	0.00
1889	37.9	37.0	37.5	37.5	76	74	70	7	8	4	2.05	1.62	0.63	1.43	2.77	2.55	2.50	0.87	0.15	0.05
1890	44.5	43.0	42.6	43.4	78	78	84	16	13	17	2.50	1.19	0.61	1.43	4.42	3.14	1.35	0.91	0.38	0.02
1891	40.3	40.5	38.8	39.9	87	87	86	4	2	-10	0.83	0.31	0.12	0.42	2.96	1.04	0.50	T.	T.	T.
1892	41.5	42.6	40.9	40.5	72	79	79	12	10	8	0.83	0.39	0.31	0.52	1.91	0.76	0.72	0.10	0.00	T.
1893	40.8	40.9	38.0	39.9	82	88	92	9	0	0	1.28	0.85	0.20	0.78	2.12	2.35	0.47	0.74	T.	T.
1894	43.1	43.9	42.2	43.1	88	90	90	1	0	1	0.85	0.11	0.04	0.33	2.24	0.65	0.44	T.	0.00	0.00
1895	42.0	41.5	39.1	40.9	82	79	80	-1	-2	-2	2.26	1.28	0.74	1.43	4.19	2.50	1.65	0.62	0.55	0.20
1896	40.6	37.8	34.2	37.7	78	78	82	-4	-1	-13	1.50	1.02	0.25	0.92	3.14	1.78	0.58	T.	T.	T.
1897	43.6	42.0	40.6	42.2	85	88	89	0	0	-1	0.50	0.10	0.10	0.27	1.23	0.68	0.50	0.00	T.	0.00
1898	40.1	39.2	39.8	39.7	78	89	86	-10	-6	-10	1.41	1.01	0.67	1.10	2.72	1.75	1.55	0.30	0.30	T.
1899	49.5	48.7	45.5	48.4	81	80	81	11	10	9	1.24	1.13	1.82	1.34	2.75	2.42	2.51	0.31	0.21	1.15
1900	42.4	41.8	41.0	41.9	81	86	90	4	2	-2	1.00	0.34	0.09	0.56	2.03	0.80	0.27	0.33	0.06	0.00
1901	45.2	45.1	44.1	44.9	83	79	82	14	14	10	1.11	0.55	0.10	0.65	2.27	1.77	0.50	0.50	T.	0.00
1902	48.6	45.9	43.2	46.4	81	85	83	14	9	8	2.68	1.30	0.18	1.53	6.26	3.08	1.07	1.53	0.00	0.00
1903	41.7	42.1	41.5	41.8	80	80	85	8	4	-5	1.18	0.95	0.64	0.97	2.28	2.10	1.05	0.58	T.	0.20
1904	47.1	46.1	44.7	46.2	84	83	80	10	10	0	0.22	0.12	0.07	0.15	0.60	0.40	0.35	T.	T.	0.00
1905	46.4	46.0	44.7	45.9	78	81	78	6	4	7	2.37	2.66	2.11	2.41	3.83	4.05	3.46	1.12	1.50	0.65
1906	41.9	41.6	40.0	41.4	81	80	80	5	-4	-8	2.92	1.51	0.80	1.94	5.28	4.15	1.81	1.08	T.	0.15
Averages and extremes for 20 years	43.0	42.4	40.4	42.1	88	90	92	-20	-16	-20	1.46	0.84	0.50	0.99	6.26	4.15	3.46	0.00	0.00	0.00
December.																				
1887	29.1	28.1	26.6	28.3	66	69	65	-10	-14	-18	1.42	0.75	0.40	1.06	2.55	1.05	0.54	0.20	0.00	0.00
1888	35.4	36.1	35.1	35.9	69	74	70	-3	1	4	1.21	0.18	0.16	0.52	3.89	1.03	0.80	0.50	T.	0.00
1889	45.0	43.8	43.5	43.9	80	75	78	0	2	1	0.17	0.01	T.	0.04	1.04	0.27	0.01	0.00	0.00	0.00
1890	36.5	36.6	35.7	36.3	76	72	78	0	4	4	0.89	0.61	0.06	0.52	2.00	1.30	0.50	0.02	0.00	0.00
1891	39.0	38.1	34.2	37.0	76	72	81	-2	-2	-7	1.95	1.20	1.30	1.48	3.49	2.82	2.15	0.82	0.01	0.34
1892	27.6	27.1	26.8	27.2	74	72	75	-15	-11	-12	2.29	1.56	0.62	1.49	4.06	2.79	1.50	1.30	0.12	T.
1893	37.0	37.2	34.9	36.4	72	75	75	1	-8	-1	0.50	0.40	0.23	0.38	1.33	1.01	0.50	T.	0.10	T.
1894	37.0	36.0	31.1	34.7	76	85	85	-10	-21	-20	1.14	0.85	0.72	0.90	2.75	1.72	1.33	0.28	0.17	0.20
1895	33.4	35.4	32.9	33.4	69	70	75	-5	-1	-9	4.24	1.37	0.43	1.78	12.45	2.40	1.40	0.42	0.03	0.02
1896	39.7	40.3	38.8	39.6	73	78	75	8	9	5	0.60	0.35	0.26	0.44	2.60	0.70	1.40	0.04	T.	0.00
1897	28.2	29.9	29.1	29.0	70	67	83	-10	-16	-15	0.64	0.59	0.46	0.78	3.06	1.22	1.80	0.52	0.17	T.
1898	28.0	27.9	27.1	27.8	66	66	65	-10	-8	-23	2.02	1.72	1.16	1.73	3.62	2.65	2.80	0.60	0.33	0.29
1899	30.8	32.1	30.7	31.4	73	73	71	-10	-7	-12	1.58	1.33	0.54	1.22	3.95	2.65	0.90	0.92	0.43	0.15
1900	35.7	35.1	34.2	35.2	68	73	78	-7	-5	-15	0.37	0.42	0.19	0.34	0.73	0.93	0.54	0.05	0.07	T.
1901	29.8	30.8	31.7	30.6	72	79	75	-12	-13	-17	1.15	0.27	0.32	0.61	2.46	0.80	0.70	0.25	T.	0.05
1902	29.8	27.3	27.2	28.4	66	77	74	-4	-11	-12	1.67	0.84	0.53	1.12	2.57	1.36	1.70	0.81	0.40	0.10
1903	32.9	34.7	34.2	33.8	71	73	73	-3	3	0	0.80	0.17	0.13	0.43	1.97	0.75	0.45	0.12	0.00	T.
1904	32.5	30.8	31.5	31.7	77	75	79	-2	-8	-4	0.72	0.51	0.75	0.64	1.52	1.09	1.30	0.26	0.17	0.47
1905	33.2	33.1	32.3	33.0	67	63	66	4	3	2	0.35	0.08	T.	0.18	0.82	0.35	0.03	T.	T.	0.00
1906	37.4	36.9	38.3	37.4	76	73	75	3	1	1	0.96	0.63	0.36	0.70	2.65	1.25	0.80	0.21	0.07	T.
Averages and extremes for 20 years	33.9	33.9	32.8	33.6	80	85	85	-15	-21	-23	1.23	0.69	0.43	0.83	12.45	2.82	2.80	0.00	0.00	0.00

TABLE 2.—*Climatological data for Kansas.*

Year.	Temperature (in °F.).								Precipitation (in inches).					
	Annual means.				Annual extremes.				Annual means.			Annual extremes.		
	Eastern division.	Middle division.	Western division.	State.	Maximum.	Month.	Minimum.	Month.	Eastern division	Middle division.	Western division.	State.	Greatest monthly mean.	Month.
1887	55.5	56.3	53.8	54.4	110	July, August	—32	January	27.22	25.25	20.28	23.07	4.34	August.
1888	53.4	54.1	51.7	53.5	109	....do	—32	....do	34.12	20.84	18.62	24.17	4.39	Do.
1889	53.4	54.4	52.9	53.6	108	July	—17	February	37.01	32.52	19.51	29.47	5.48	May.
1890	54.9	54.9	54.8	54.8	113	....do	—22	January	31.79	23.58	14.33	20.65	4.06	August.
1891	53.9	53.1	51.9	53.0	108	August	—10	February	34.00	32.79	29.21	30.90	6.28	June.
1892	53.3	53.5	51.6	52.6	111	....do	—34	January	39.63	27.78	17.98	29.06	6.90	May.
1893	53.8	54.7	52.6	53.7	113	June, July	—15	February	30.23	18.58	11.93	20.12	3.91	June.
1894	55.2	55.5	52.9	54.7	116	July	—26	July	28.76	21.25	12.19	20.72	4.94	Do.
1895	54.0	54.3	51.7	53.2	112	....do	—25	February	37.99	24.88	21.39	27.86	5.53	July.
1896	56.3	56.3	54.6	55.2	114	June	—18	January	35.77	30.82	19.58	29.26	4.75	May, July.
1897	55.6	55.5	53.8	55.1	113	....do	—16	January, December.	27.56	22.91	22.91	24.58	3.69	August.
1898	54.4	54.3	53.0	54.2	110	July	—23	December	42.72	29.39	22.13	32.85	6.28	May.
1899	54.3	54.6	53.4	54.3	110	June	—34	February	33.20	27.98	18.11	28.01	5.53	June.
1900	56.0	56.6	55.3	56.0	110	....do	—15	December	37.61	27.39	18.51	29.65	6.37	September.
1901	55.6	55.6	54.1	55.4	112	July	—21	January	26.00	20.89	17.91	22.15	3.64	April.
1902	54.3	54.3	53.9	54.2	112	August	—22	....do	45.71	34.30	22.24	35.50	6.64	May.
1903	53.9	53.6	52.2	53.4	110	July	—22	February	41.88	32.41	19.78	33.46	8.57	Do.
1904	54.4	54.2	53.6	54.2	104	August	—19	January	41.72	30.11	21.22	32.86	8.80	June.
1905	54.1	53.7	52.1	53.5	108	June	—40	February	39.85	29.53	22.94	32.09	7.92	September.
1906	55.2	54.3	53.3	54.4	105	August	—15	March	34.00	28.65	23.16	29.48	5.56	June.
Twenty years	54.6	54.7	53.2	54.2	116	July	—40	February	35.34	27.09	19.70	27.77	8.80	June.

PRECIPITATION.

The average annual precipitation ranges from 15.37 inches in the extreme western to 44.54 inches in the extreme southeastern part of the State. The average number of rainy days per year increases from 49 in the extreme western counties to 99 in the eastern. The average precipitation for winter ranges from 1 inch in the western counties to 4 inches in the eastern. The average for spring ranges from 4 inches in the western counties to 12 inches in the eastern; for summer it ranges from 8 inches in the west to 14 inches in the east, and for autumn from 2 inches in the west to 8 inches in the east. The total annual precipitation during the driest year ranged from 9.30 inches at Viroqua, Morton County, to 29.62 inches at Columbus, in Cherokee County, and for the wettest year it ranged from 21.16 inches at Wallace, Wallace County, to 57.97 at Lebo, Coffey County, and 58.30 at Columbus, Cherokee County.

SNOWFALL.

The average annual snowfall ranges from 8.6 inches in Montgomery County to 25.6 inches in Atchison County, while in the western part of the State this order is reversed and we find it ranging from 18.1 inches in Thomas County to 21.2 inches in Morton. In the central part of the State McPherson County bears the palm with an annual average of 24 inches. The average annual number of days with measurable snowfall is least in the southern tier of counties, where it ranges from six to nine days, and greatest in the northeastern counties, where it is 15 and upward. The greatest snowfall in twenty-four hours is quite uniform over the State, ranging from 8 to 10 inches, but in the lower Solomon and Republican River valleys it increases to 11 and 12 inches. Around the headwaters of the Little Arkansas River, in McPherson County, it is 14 inches; in the valley of the Kaw it is 18 inches; in Morton, the extreme southwestern county, it is 20 inches.

THUNDERSTORM DAYS.

The average annual number of days with thunderstorms ranges from less than 20 in the extreme southwestern counties to over 40 in the eastern. Wichita, in Sedgwick County, has the greatest number, its record showing 49 days. Otherwise the number of days with thunderstorms is quite uniform, except in the extreme western and extreme eastern counties, ranging between 34 and 37.

HAILSTORM DAYS.

The average number of days with hailstorms is 2 in the extreme southeastern counties and 3 over the rest of the State, except in Trego, Ford, and Sedgwick counties, where the number is increased to 4.

LIGHTNING AND POWERFUL ELECTRIC DISCHARGES.

In a memoir on "High Electromotive Force" by Prof. John Trowbridge, of Harvard University, published in Vol. XIII of the Memoirs of the American Academy of Arts and Sciences, the author gives a full description of his remarkable battery of 20,000 small cells, giving an electromotive force of 40,000 volts.

Such a battery gives discharges one or two yards long that simulate lightning itself and lead to the following remarks by the author elucidating this phenomenon.

* * * Meteorological observations lead us to conclude that the lightning discharge is not produced like the discharge from a great number of storage cells arranged in series – that is, from one charged particle of water vapor to another—but rather from the accumulation in series of such charges at some point on the surface of the cloud, the cloud thus acting like a charged condenser. We can thus suppose that the outer layer of particles of water are more heavily charged than those in the interior of the cloud. * * *

It seemed evident from observation of the phenomena that air at atmospheric pressure breaks down with great facility under high voltage combined with large amperage.

* * * * * * *

One is impressed in studying high voltage combined with large amperage that the study of electrical discharges by means of Holtz machines or other forms of glass inductors leads to limited conceptions of the amount of energy in lightning discharges. If Benjamin Franklin had worked with a high-tension storage battery, he probably never would have dared to try his celebrated kite experiment. Experience has shown that even five hundred volts combined with large current is sufficient to cause death.

* * * * * * *

The discharges from a large number of condensers, charged in multiple and discharged in series, are probably more nearly identical with lightning discharges than any other forms of discharges within our experimental means; and the photographs of such discharges reveal details which do not appear in the discharges from Ruhmkorff coils or Tesla coils.

With a large portrait lens many of such details appear which are not shown by small lenses. These details, however, are difficult to reproduce. Indeed it often happens in scientific investigation that one obtains faint images which can not be reproduced by any process of printing, and which do not give satisfactory results with ordinary pro-

cesses of intensification or methods of repeated printing from quick plates to slow plates.

* * * * * * * *

In the case of very long sparks, six feet, or more, the bifurcations are generally directed to neighboring conducting masses, and are not directed to the cathode. In the case of lightning, masses of clouds at a low potential, not lying along the main direction of discharge, are indicated by these side forking discharges.

* * * * * * * *

Some years ago I showed that an explosion occurs whenever powerful sparks change their direction in zig zags. The spark passed between a plate of glass and a sheet of paraffined paper, and it was found that the paper was perforated at each forking of the discharge. Possibly these explosions occurring along an extended lightning discharge may be an important element in the phenomenon of the rolling thunder, for the sound of such explosions would arrive at considerable intervals apart.

An interesting account of the explosive effect at each turning point of a lightning discharge has been given me by Mr. Harvey N. Davis, an instructor in the Jefferson Physical Laboratory, and I give it here, since it is an account by a skilled observer of both the above explosive effects and ball lightning.

"During the 27th of August, 1906, a large boarding-house on the side of Mount Moosilauke, in the town of Warren, N. H., was struck by lightning in an unusually sudden and severe thunderstorm. The path of at least three independent discharges could be traced, but they must have been practically simultaneous, for those who had been caught by the rain half a mile from the house heard only one sharp report. One of the discharges struck the end of the ridgepole of the barn, and came down the wall to a very obvious ground; and two others landed halfway up the sloping roof of the nearest part of the house, one of them near, but not on a dormer window, and the other at some distance from any sort of a projection such as would ordinarily be expected to 'draw lightning.' In each place there was a spot about a foot across where the shingles had been forced outwards, as though by an explosion just under them, while inside there were two round holes four or five inches in diameter where the plaster had been blown into the room, leaving the laths completely bare. The first of these discharges travelled down the roof to the eaves, and jumped to the telephone wires, bursting out the shingles again as it left the roof. It happened that one of the young women of the house had just closed the dormer window, and was in the middle of the room with her head close to that part of the sloping ceiling where the second of the holes was found. It is possible that this was merely chance, or, on the other hand, her presence may have had some inflence on the direction of the original discharge; at any rate, the discharge jumped to her right shoulder, and passed through or over the surface of her body to her left foot, then ran along the floor to the wall, leaving a mark such as might be made with a hot poker, and finally reached earth through the side of the house. The young woman was, of course, completely stunned, but was fortunate enough to escape serious injury. An interesting feature of this discharge was the regularity with which it seemed to explode every time it turned a corner. The explosions between the ceiling and the roof have already been mentioned; the next occurred when the discharge reached the woman's foot. Her shoe and stocking were blown completely off, so that only the left half of the upper of the shoe remained attached to the sole. From her foot it ran along the floor to a tin pail, which was standing on a piece of linoleum, and here it exploded again, overturning the pail, and demolishing the linoleum, some of which was found inside a water pitcher on a stand near by, while one or two shreds reached an adjacent windowpane with force enough to stick between the glass and the sash. Finally, the point where the lightning reached the wall and started down between the sheathing and plaster was very plainly marked on the outside of the house, a couple of clapboards being forced out several inches. In the room below, the plaster was loosened from the laths all the way down, probably by the pressure of the heated air, but the appearance was quite different from that of the ceiling in the room above. Fortunately nothing took fire.

"At the time of the discharge the guests were in the dining-room at the other side of the house, and several of those who turned most quickly saw slow moving ball discharges just outside the window. One of those with whom I talked, a trained scientist, was sitting with his back partly turned, and saw only one ball of fire, 'like a glowing coal;' but others said that it had been preceded by one rather larger, perhaps as large as a baseball. When he first saw the second ball, it was three or four feet from the ground, and was falling obliquely, as though it had rolled oft the roof of a low ell near by, and its velocity was only a few feet per second, certainly not enough to leave a streak on his retina, as he noticed at the time. We searched that night, and again carefully the next day, for traces of these discharges in the ground, but could find none. Whether they were independent discharges from the main cloud, or were secondary effect, due to the electrification of the wet roof, I do not know. At any rate, they were not immediately connected with either of the three main discharges, for two of these went to obvious grounds, as has been indicated; and the telephone wires, which carried off the third, were nowhere near the part of the house where these balls were seen."

In long discharges of lightning these explosions, directed [illegible] angles, could give rise to sound waves, which, starting practically at the same instant, nevertheless, by different angles and degrees of reflection, could arrive at the ear of the listener at considerable intervals, and produce the rolling of thunder.

What, then, are the conclusions that can be drawn from the foregoing manifestations of electric discharges which can be produced by a large number of storage cells? The first fact which impresses one is the importance of the consideration of amperage as well as electromotive force. Throughout scientific literature, and in popular conception, electromotive force has received the chief consideration in discussing the phenomena of lightning. Experiments in laboratories have been conducted with electrical machines which are generally incapable of affording much current. Franklin's experiment with the aid of a kite illustrates an underestimate of the current in a lightning discharge. Even to-day no one would think of repeating Franklin's celebrated experiment, largely from a dread of voltage, but with little conception of the possibility of danger from small voltage and large current. We are beginning to realize, however, that 500 volts, accompanied by a current of from 10 to 20 amperes, is sufficient to destroy human life. One compartment of the storage battery which I have described in this memoir—a compartment affording something over 800 volts—short-circuited through the body of the janitor of the laboratory, was sufficient to knock him senseless.

The most powerful electric discharge which we can produce by modern appliances in a faint shadow of lightning—so faint that it fails to reproduce in most essential respects the phenomena in the heavens. I have never been able, by the use of resonant tubes or other arrangements, to cause reverberations to reproduce in the slightest degree, even with sparks six feet in length, the rolling of thunder. The energy of an ordinary lightning discharge must be enormous.

The forms of lightning discharges are very varied, and when one asks whether lightning is oscillatory, one should specify the kind of discharge.

A COLLECTION OF MEAN ANNUAL TEMPERATURES FOR MEXICO AND CENTRAL AMERICA.

By PHILIP P. CALVERT, Ph. D. Assistant Professor of Zoology, University of Pennsylvania, Philadelphia, Pa.

In studying the distribution of the Odonata, or dragonflies, of Mexico and Central America, particularly with reference to temperature, the writer prepared a colored map illustrating the distribution of mean annual temperatures in those countries. This map is shortly to appear as a plate in the Biologia Centrali-Americana volume Neuroptera (London). It is based partly on two similar older maps,[1] partly on a body of temperature data specially gathered from many scattered sources in the libraries of Philadelphia and of the United States Weather Bureau at Washington. As these data will probably be of use to climatologists and others, they are here brought together in tabular form. Since the authorities cited for temperature records often give other climatic data also, the column "Authority for temperature records" will also serve as a selected bibliography on meteorological phenomena in these countries. In the search for the earlier authorities much assistance was derived from Sr. Aguilar y Santillan's "Bibliografia Meteorologica Mexicana" in the Memorias de la Sociedad Cientifica Antonio Alzate, IV, p. 5–47, 265–276, 1890. The student of Mexican temperatures will also find Sr. J. Guzman's "Climatología de la República Mexicana desde el punto de vista higiénico" in the same Memorias, XX, p. 181-

[1] 1. A map, 97 by 71.5 centimeters, in the library of the Academy of Natural Sciences of Philadephia, inscribed merely "Carta Climatologica. Sebastian Reyes. P. J. Senties. A. Donamette Imp. Escala de 1:3,000,000. Gravée chez Monrocq fr. Paris." Thanks to the Secretaria de Estado y del Despacho de Fomento, Colonizacion e Industria de Mexico, I am informed, under date of July 30, 1907, "que dicha Carta fué publicada en 1889 por disposicion de esta Secretaría, haciendo los trabajos relativos los Sres. Pedro J. Senties, que era Director de la Escuela Nacional de Agricultura y Comisionado de México en la Exposicion de Paris del mismo año y Sebastian Reyes que fué Profesor del Plantel antes mencionado." This map was reproduced without alteration, but on a reduced scale (1:6,000,000), in Tomo XI, Anales del Ministerio de Fomento de la Republica Mexicana, Mex., 1898.

2. A map entitled "Reparticion de la Temperatura en la República Mexicana" for the "Año Meteorológico de 1902," published as Planche 16, Boletin Mensuel, Observatorio Meterológico-Magnetico Central de México, Noviembre, 1902. Señor Don Manuel E. Pastrana, Director of the Observatorio, has kindly informed me (September 6, 1907) that the maps for later years have not yet been published.

TABLE 1.—*Mean annual temperaturez in Mexico.*

Locality.	State.	Latitude north.	Altitude.		Mean annual temperature.		Period of observation.		Authority for temperature records.
		° '	Feet.	Meters.	°C.	°F.	Years.	Date.	
Acapulco	Guerrero	16 50	14	4	27.5	81.5	11 mos.	1901-1902	BOM 1901 and 1902.
Acayucan	Vera Cruz	17 57	518	158	24.5	76.1	5		CRM II, p. 136.
Actopan	do	19 30	1,020	311	25.0	77.0	6		Do.
Acula	do	18 30			24.4	76.0	5		Do.
Aguascalientes	Aguascalientes	21 53	6,104	1,861	18.1	64.6	2		Hann.
Alpatlahua	Vera Cruz	19 7*	5,540	1,689	14.8	58.6	7		CRM II, p. 134.
Alvarado	do	18 46	29	9	26.4	79.5	6		CRM II, p. 136.
Antigua, La	do	19 19*			24.9	76.8	4		Do.
Apazapan	do	19 19*	1,181	360	24.8	76.6	5		Do.
Atzalan	do	19 47*			16.0	60.8	5		CRM II, p. 134.
Axocuapan	do				15.4	59.7	7		Do.
Catemaco	do	18 25	1,305	398	24.3	75.7	6		CRM II, p. 135.
Chacaltianguis	do	18 19*			23.8	74.8	4		Do.
Chiconamel	do				24.1	75.4	5		Do.
Chicontepec	do	20 58	1,952	595	22.0	71.6	6		Do.
Chihuahua	Chihuahua	28 38	4,759	1,451	18.2	64.8	2	1901, 1902	BOM 1901, p. 224; 1902, p. 625.
Chontla	Vera Cruz	21 18*			23.0	73.4	5		CRM II, p. 135.
Coatepec	do	19 27*	4,107	1,252	19.2	66.6	4		CRM II, p. 134.
Coatzacoalcos	do	18 9	6	2	26.3	79.3	5		CRM II, p. 136.
Do	do				24.8	76.6	58 mos.	1899-1904	MWR 1899-1904.
Colima	Colima	19 11	1,601	488	26.1	79.0	12	1869-1880	Barreto, Revista Cient. Mex. i. No. 12, 1880.
Do	do				24.5	76.1	5	1896, 1897, 1899, 1901, 1902	BOM 1897, 1899, 1902. MS 1901; CRM II, p. 14.
Comapa	Vera Cruz				19.7	67.5	7		CRM II, p. 134.
Cordoba	do	18 54	2,860	872	20.5	68.9	5	1861-1865	Challenger Repts.
Do	do				20.0	68.0	7		CRM II, p. 134.
Cosamaloapan	do	18 22	295	90	24.5	76.1	7		CRM II, p. 136.
Coscomatepec	do	19 4	5,209	1,588	16.8	62.2	7		CRM II, p. 134.
Cosquihui	do				22.9	73.2	5		CRM II, p. 135.
Cuernavaca	Morelos	18 55	4,936	1.505	20.5	68.9	2	1873-1874, 1907	Reyes, Bol. Soc. Geog. Estadist. Rep. Mex. (3a), IV, p. 90 et seq., 1878. MS 1907.
Culiacan	Sinaloa	24 48	111	34	25.2	77.4	5	1891-1894, 1900	BOM 1894, 1900. MS 1891, 1893.
Durango	Durango	24 1	6,207	1,892	17.3	63.1	2	1899, 1900	BOM 1899, 1900.
Guadalajara	Jalisco	20 41	5,186	1.581	19.7	67.5	12	1880-1885, 1889, 1894, 1896, 1897, 1902, 1903.	Barcena, Anales Min. Fomento. Rep. Mex. IX, p. 277-328, 1891. BOM 1889, 1895, 1897, 1902; CRM II, p. 14; MWR 1902, 1903.
Guanajuato	Guanajuato	21 1	6,757	2.060	18.1	64.6	8	1888-1889, 1895-1899, 1902.	BOM 1889, 1895-1899, 1902; CRM I, p. 20, II, p. 15.
Guaymas	Sonora	27 56			23.9	75.0	1	1902	BOM 1902.
Gutierrez Zamora	Vera Cruz	20 24*			23.2	73.8	3		CRM II, p. 135.
Huatusco	do	19 9	4,408	1,344	17.7	63.9	5		CRM II, p. 134.
Huayacocotla	do	20 38*			12.0	53.6	4		Do.
Huejutla	Hidalgo	21 9	1,246	380	22.7	72.9	2		Hann.
Ilamatlan	Vera Cruz				17.8	64.0	6		CRM II, p. 134.
Ixhuacan	do	19 21*			13.3	55.9	5		Do.
Ixhuatlan	do	20 41	1,004	306	23.4	74.1	6		CRM II, p. 135.
Ixtacomitan	Chiapas	17 10*	689	210	24.4	76.0	1	1884	MZ 1895, p. 387.
Jalacingo	Vera Cruz	19 49			13.9	57.0	4		CRM II, p. 134.
Jalapa	do	19 32	4,756	1,450	17.7	63.9	13	1895-1907	MS.
Jaltipan	do	17 58	436	123	26.5	79.7	5		CRM II, p. 136.
Jicaltepec	do	20 10	341	104	22.3	72.1	2		CRM II, p. 135.
Juchique	do	19 50*			21.1	70.0	5		Do.
Lagos	Jalisco	21 21	6,277	1,912	18.2	64.8	2	1879, 1896	Reyes, 1880. CRM II, p. 15.
Leon	Guanajuato	21 7	5,901	1,799	18.7	65.7	25	1878-1902	Bol. Obs. Met., Leon 1897; MZ 1897, p. 232; BOM 1897-1902; MWR 1897-1902.
Lerdo, Ciudad	Durango	25 33*	3,725	1,135	23.1	73.6	1	1902	BOM 1902.
Linares	Nuevo Leon	{24 42 / 24 57*}	1,190	363	22.4	72.3	5½	1896-1901	BOM 1902, p. 22.
Magdalena	Vera Cruz	18 46*	5,087	1,551	18.4	65.1	5		CRM II, p. 134.
Do	Sonora	30 38	4,946	1,508	21.7	71.0	2	1896, 1897	Romero, p. 39. MWR 1897.
Maltrata	Vera Cruz	18 48*	5,255	1,602	17.0	62.6	6		CRM II, p. 134.
Martinez de la Torre	do	20 4	495	151	23.7	74.7	6		CRM II, p. 135.
Matamoros	Tamaulipas	25 53	49	15	23.2	73.8	9		Hann.
Mazatlan	Sinaloa	23 11	25	7.5	24.9	76.8	23	1880-1902	BOM 1901, 1902, and MS.
Mecayapan	Vera Cruz	18 13	1,115	340	22.9	73.2	5		CRM II, p. 135.
Medellin	do	19 3*	171	52	22.0	71.6	6		Do.
Merida	Yucatan	20 55	49	15	25.8	78.4	7	1895-1898, 1900-1902.	CRM I, p. 21; II, p. 15; MWR, 1897; BOM, 1898, 1900-1902.
Mexico City	Distrito Federal	19 26	7,469	2,277	15.5	60.0	26	1877-1902	MZ, 1897, p. 66; BOM, 1896-1902.
Minatitlan	Vera Cruz	17 59	213	65	24.1	75.4	4		CRM II, p. 135.
Mirador	do	19 15	3,293	1,004†	20.1	68.2	16	1854-1870	Schott; Sartorius, Bol. Soc. Geog. Estad. Rep. Mex. (2) I, p. 367-9 (1869).
Misantla	do	19 56	1,345	410	22.8	73.0	3		CRM II, p. 135.
Monterey	Nuevo Leon	25 40	1,624	495	21.5	70.7	{10 / 3}	1898, 1899, 1902.	Hann. BOM, 1898, 1899, 1902.
Morelia	Michoacan	19 42	6,399	1,951	16.8	62.2	9	1894-1902	BOM, 1895-1902; CRM I, p. 20; II, p. 14; MWR 1896-1902.
Naolinco	Vera Cruz	19 40*			16.0	60.8	5		CRM II, p. 134.
Naranjal	do	18 49*	2,558	780	21.3	70.3	5		CRM II, p. 135.
Nautla	do	20 13	10	3	23.1	73.6	2		Do.
Nogales	Sonora	31 20	3,857	1,176	17.2	63.0	1	1901-1902	BOM, 1901, 1902.
Oaxaca	Oaxaca	17 4	5,119	1,561	20.3	68.5	21	1879, 1883-1898, 1900-1905.	Reyes, 1880; MZ, 1896, p. 266; 1897, p. 385; 1905, p. 477; 1906, p. 467; BOM, 1895-1902 and ms.; CRM I, p. 20; II, p. 14.
Orizaba	Vera Cruz	18 51	4,215	1,285	18.2	64.8	6		CRM II, p. 134.
Otatitlan	do	18 11*	151	46	25.1	77.2	3		CRM II, p. 136.
Ozuluama	do	21 40	751	229	23.8	74.8	7		CRM II, p. 135.
Pabellon	Aguascalientes	22 4	6,311	1,924	18.1	64.6	12	1878-1889	BOM, 1888, p. 33; 1889, p. 370, 439.
Pachuca	Hidalgo	20 7	7,954	2,425	14.6	58.3	8	1894-1900, 1902.	BOM, 1895-1900, 1902; CRM I, p. 20; II, p. 14.
Panuco	Vera Cruz	22 3*	66	20	22.9	73.2	6		CRM II, p. 135.
Papantla	do	20 27	977	298	22.7	72.9	5		Do.
Parras	Coahuila	25 28	5,033	1,534	23.1	73.6	23 mos.	{1897-1898 / 1899}	MWR, 1897, 1898. Mex. Intern. R. R. Co., 1900, timetable.
Paso de Ovejas	Vera Cruz	19 17*	423	129	25.4	77.7	2		CRM II, p. 136.
Patzcuaro	Michoacan	19 31	7,013	2,138	16.1	61.0	1	1879	Reyes, 1880.
Perla, La	Vera Cruz	18 57*			17.0	62.6	6		CRM II, p. 134.
Perote	do	19 34	8,085	2,465	10.5	50.9	6		Do.
Playa Vicente	do	17 50	312	95	24.1	75.4	4		CRM II, p. 135.
Porfirio Diaz, Ciudad	Coahuila	28 42*	722	220	21.3	70.3	7	1897-1903	MWR, 1897-1903.
Puebla	Puebla	19 2	7,118	2,170	15.9	60.6	25	1878-1902	Urrutia, Actas, etc., primer Congreso Meteor. de 1900, p. 165; BOM, 1900-1902.
Pueblo Viejo	Vera Cruz	22 12*			23.6	74.5	7		CRM II, p. 135.
Queretaro	Queretaro	20 36	6,068	1,850	18.1	64.6	8	1894-1900, 1902.	BOM, 1895-1900, 1902; CRM I, p. 21; II, p. 14.

TABLE 1.—*Mean annual temperatures in Mexico*—Continued.

Locality.	State.	Latitude north.	Altitude.		Mean annual temperature.		Period of observation.		Authority for temperature records.
			Feet.	Meters.	°C.	°F.	Years.	Date.	
		° ′							
Real del Monte	Hidalgo	20 8	9,092	2,772	12.3	54.1	8	1889, 1894, 1896-1900, 1902.	BOM 1889, p. 369; 1895-1900, 1902; CRM II, p. 14.
Salina Cruz	Oaxaca	16 10	7	2	28.8	83.8	11 mos.	1902	BOM, 1902.
Saltillo	Coahuila	25 26*	5,379	1,640	17.6	63.7	10	1888, 1889, 1894-1900, 1902	BOM, 1889, p. 370, 439; 1895-1900, 1902; CRM I, p. 21; II, p. 15.
Do	do				17.1	62.8	10		Hann.
San Andres Tuxtla	Vera Cruz	18 27	1,184	361	24.0	75.2	6		CRM II, p. 135.
San Cristobal Llave	do	18 43*‡			25.1	77.2	3		CRM II, p. 136.
San Juan Bautista	Tabasco	17 54	33	10	26.6	79.9	1	1892-1893	MZ, 1896, p. 478.
San Juan del Rio	Queretaro	20 22§	6,481	1,976	18.3	65.0	1	1879	Reyes, 1880.
San Juan Evangelista	Vera Cruz	17 53	289	88	23.5	74.3	5		CRM II, p. 135.
San Luis Potosi	San Luis Potosi	22 9	6,201	1,890	17.6	63.7	19	1879-1889, 1892, 1894-1897, 1899, 1900, 1902.	BOM, 1888, 1889, 1895-1897, 1899, 1900, 1902; MZ, 1894, p. 72; CRM I, p. 21; II, p. 15.
Santiago Huatusco	Vera Cruz				25.6	78.1	2		CRM II, p. 136.
Santiago Tuxtla	do	18 28*	935	285	23.8	74.8	5		CRM II, p. 135.
Santo Domingo	do	20 18*			18.7	65.7	5		CRM II, p. 134.
Silao	Guanajuato	20 56	6,061	1,848	19.4	67.0	4	1894, 1896, 1897, 1899.	BOM, 1895, 1897, 1899; CRM II, p. 15.
Soledad	Vera Cruz	19 4*	305	93	25.8	78.4	4		CRM II, p. 136.
Tacubaya	Distrito Federal	19 24	7,529	2,323	15.5	60.0	9		Romero, p. 38.
Tamiahua	Vera Cruz	21 16	0	0	24.2	75.6	3		CRM II, p. 135.
Tampico	Tamaulipas	22 16	0	0	24.0	76.0	4		Hann; BOM 1901, 1902.
Tantima	Vera Cruz	21 20	925	282	23.4	74.2	7		CRM II, p. 135.
Tantoyuca	do	21 21			23.0	73.4	6		Do
Tapachula	Chiapas	14 54*	590	180	28.8	83.8	2	1884-1885	Mattern, Mem. Soc. Cien. Antonio Alzate, I, p. 550-552, 1887.
Tehuipango	Vera Cruz	18 31	7,813	2,382	14.3	57.7	5		CRM II, p. 134.
Tempoal	do	21 28*			23.5	74.3	6		CRM II, p. 135.
Teocelo	do	19 23*	3,995	1,218	19.6	67.3	5		CRM II, p. 134.
Tepezintla	do	21 8*			22.9	73.2	5		CRM II, p. 135.
Tequila	do	18 44*	5,389	1,643	14.9	58.8	6		CRM II, p. 134.
Teziutlan	Puebla	19 49	6,501	1,982	15.6	60.1	1	1879	Reyes 1880.
Tihuatlan	Vera Cruz	20 43	729	222	24.4	76.0	5		CRM II, p. 135.
Tlacolulan	do	19 39*	5,448	1,661	14.8	58.6	3		CRM II, p. 134.
Tlacotalpan	do	18 37*	10	3	25.1	77.2	5		CRM II, p. 136.
Tlalixcoyan	do	18 48	275	84	24.7	75.5	5		Do
Toluca	Mexico	19 17	8,610	2,625	13.7	56.7	9	1894-1902	BOM, 1895, 1897, 1898, 1900-1902; CRM I, p. 21; II. p. 14; Bol. Red Meteor. Estado Mex., 1899, p. 132.
Topolobampo	Sinaloa	25 35*			23.9	75.0	35 mos.	1897, 1899-1901	MWR. 1897, 1899-1901.
Tuxpan	Vera Cruz	20 59	0	0	24.8	76.6	6		CRM II, p. 136.
Tuxtla Gutierrez	Chiapas	16 32	1,738	530	24.6	76.3	3	1898-1900	BOM, 1898-1900.
Vera Cruz	Vera Cruz	19 12	49	15	25.0	77.0	22	1791-1803, 1847-1859, 1891-1894, 1896, 1902	Schott; BOM, 1902 and ms.
Veta Grande	Zacatecas	22 50	8,030	2,448	14.1	57.4	2	1839-1840	Schott.
Vigas, Las	Vera Cruz	19 38*	7,943	2,421	11.1	52.0	6		CRM II, p. 134.
Yecuatla	do	19 52*			21.4	70.5	5		CRM II, p. 135.
Zacatecas	Zacatecas	22 46	8,013	2,443	14.3	57.7	24	1878-1900, 1902.	BOM, 1888, 1889, 1895-1900, 1902 and ms.; CRM I, p. 20; II, p. 15.
Zapotlan	Jalisco	19 36	5,122	1,562	19.8	67.6	6	1894, 1896, 1899-1902	BOM, 1895, 1899-1902; CRM II, p. 14.
Zentla	Vera Cruz	19 7*			21.0	69.8	7		CRM II, p. 134.
Zongolica	do	18 40	4,107	1,252	18.6	65.5	5		Do

† This is the revised altitude given by Barcena (Anales Minist. Fomento, VII, p. 280, 1882); the earlier figures were 1095 meters (cf. Hann). ‡ None of the maps of Mexico show a S. Cristobal in the Canton of Vera Cruz, as CRM II, p. 136, locates it, but in the Canton of Cosamaloapan. § Romero's (p. 38) latitude of 19° 49′ for San Juan del Rio is not supported by the maps.

288, 1903, and Sr. J. Ramirez's "La Vegetación de México" in Anales del Ministerio de Fomento Rep. Mex. XI, pp. 227 et seq., 1898, of importance.

The sources from which the data have been gathered are frequently indicated in the accompanying tables by abbreviations whose significance is as follows:

BOM. Boletin Mensuel, Observatorio Meteorológico-Magnetico Central de México. México, 1888, 1889, 1895-1902. (Data for 1897 are also reprinted in Anales del Ministerio de Fomento de la Republica Mexicana, Tomo XI, p. 467-489. Mexico, 1898.)

Challenger Repts. Scientific Results of the Voyage of H. M. S. *Challenger*. Report on Atmospheric Circulation by Alexander Buchan, in Physics and Chemistry, Vol. II, part 5, London, 1889.

CRM. El Clima de la República Mexicana por M. Moreno y Anda y Antonio Gomez. Mexico Oficina tip. de la Secretaría de Fomento. Año I for 1895, 1899; Año II for 1896. 1900.

Hann. Handbuch der Klimatologie von Dr. J. Hann. Zweite Ausgabe. Bd. II, p. 286. Stuttgart, 1897.

MWR. The MONTHLY WEATHER REVIEW, United States Department of Agriculture, Weather Bureau, Washington, D. C. Volumes for 1896-1906.

MZ. Meteorologische Zeitschrift. Wien u. Berlin.

Reyes, 1880, in Boletin, Sociedad de Geografia y Estadistica, Republica Mexicana, 3a Epoca, V, p. 160-181.

Romero. Geographical and Statistical Notes on Mexico. By Matias Romero. G. P. Putnam's Sons. New York and London. 1898.

Schott. Tables in Smithsonian Contributions to Knowledge No. 277. Washington, 1876.

Some manuscript records in the library of the United States Weather Bureau from the Observatorio Meteorológico-Magnetico Central de México are often quoted as "ms." in connection with BOM. For the privilege of examining these I am indebted to the officials of the Weather Bureau.

The data for Cuernavaca for 1907 and for Jalapa 1895-1907 are from manuscript records from the meteorological observatories at those places, which I owe to the kindness of Señor Don M. E. Pastrana, Director of the Central Observatory of Mexico.

Latitudes and altitudes are taken from the authorities quoted for the temperatures; the determinations of the Comision Geografico-Exploradora for the State of Vera Cruz, in Revista, Sociedad Cientifica 'Antonio Alzate' xxiii, p. 31-32, Mexico, 1905; Anuario del Observatorio Astronomico Nacional de Tacubaya por 1901, p. 270-327 (latitudes only); Doctor Sapper's papers on Central America in Petermann's Mittheilungen xliii (1897), l (1904) and Ergänzungbänder xxiv (1895) and xxvii (1899); Mr. Gannett's "List of Altitudes in Mexico and Central and South America," Monthly Bulletin, International Bureau of the American Republics for September, 1904, Washington; and

Table 2.—*Mean annual temperatures in Central America.*

Locality.	Department.	Latitude north.	Altitude.		Mean annual temperature.		Period of observation.		Authority for temperature records.
			Feet.	Meters.	° C.	° F.	Years.	Date.	
British Honduras.		° ′							
Belize		17 30	0	0	26.1	74.0	18	1863, 1865–1869, 1878–1883, 1885–1887, 1894–1895, 1902, 1904.	Schott; Challenger Repts.; Bristowe and Wright, Handbook of Brit. Hond., 3d edit., Edinb. and London, 1890, p. 231; MZ., 1896, 1906.
Guatemala.									
Chiacam	Alta Vera Paz	15 33*	2,788	850	21.3	70.3	4	1892, 1897–1899	MZ, 1894, 1900; Observ. Meteor. Lab. Quim. Cent. Guat., 1899 (1900).
Chimax	....do	15 32	4,284	1,306	18.7	65.7	14	1892–1905	MZ, 1907, pp. 230–231.
Guatemala City	Guatemala	14 38	4,887	1,490	18.3	65.0	45	1857–1899, 1901, 1902.	MZ, 1899, p. 570; Observ. Meteor. Lab. Quim. Centr. Guat., 1899 (1900), 1902 (1903).
Mercedes, Las	Quezaltenango	14 42*	3,280	1,000	22.7	72.9	3	1896–1898	MZ, 1897, 1899.
Puerto Barrios	Izabal	15 44*	7	2	26.8	80.3	1	1896	MZ, 1897.
Quezaltenango	Quezaltenango	14 57 / 14 50*	7,708	2,350	14.6	58.3	3	1895–1897	MZ, 1896, 1897, 1898.
Salama	Baja Vera Paz	15 8	3,018	920	23.1	73.6	1	1891–1892	MZ, 1893.
Setal	Alta Vera Paz	15 42	2,394	730	20.6	69.1	1	1892	MZ, 1894.
Villafranca	Zacapa		2,004	611	23.0	73.4	1	1899	Observ. Meteor. Lab. Quim. Cent. Guat. 1899 (1900).
Honduras.									
Tegucigalpa		14 12*	3,200	976	22.3	72.1			Internat. Bureau Amer. Repub., Handbook for Honduras, 1904, p. 13.
Salvador.									
Bahia (estero de Jiquillisco)	Usulutan	13 13*			27.5	81.2	1	1876	Anales Mus. Nac., I. No. 7, San Salvador, 1904.
Barra del Lempa	....do	13 16			27.5	81.5	1	1876	Do.
Jacuaran, Costa de	La Union	13 10* / 13 28			27.4	81.3	1	1876	Do.
Playa del Encantado	....do	13 28			27.4†	81.3	1	1876	Do.
Puerto Concordia	La Paz	13 19			27.5	81.5	1	1876	Do.
Puerto de Acajutla	Sonsonate	13 35	50	15	26.1	79.0	1	1876	Do.
Puerto de La Libertad	La Libertad	13 26			26.1	79.0	1	1876	Do.
San Salvador	San Salvador	13 42	2,099	640	23.1	73.6	14	1889–1902	MZ, 1905, p. 87.
Santa Tecla	La Libertad	13 40*	3,001	915	21.6	70.9	4	1884–1887	MZ, 1896, p. 197.
Union, La	La Union	13 19* / 13 28	33	10	28.9	84.0	1	1876	Anales Mus. Nac., San Salvador, I, No. 7, 1904.
Nicaragua.									
Bluefields	Zelaya	12 0*			26.9	80.4	3	1883–1886	Challenger Repts.
Deseado, Rio, 10 miles from Caribbean.	S. Juan del Norte	10 52*			25.3	77.6	1	1898	Rep. Nicar. Canal Comm., 1897–1899 (1899); MWR, 1899, p. 212.
Greytown	....do	10 55*			26.2	79.2	3	1898–1900	Do., and Rep. U. S. Isthm. Canal Comm., 1899-1901 (1904), p. 343–4.
Lajas, Las	Rivas	11 23*			26.6	79.9	1	1898–99	Rep. Nicar. Can. Comm., p. 307 (1899).
Ochoa (on Rio S. Juan, 40 miles from Caribbean).	S. Juan del Norte	10 47*			24.9	76.9	3	1898–1900	(Same as for Greytown.)
Rivas	Rivas	11 26*	209	61	26.8	80.2	7	1880–1886	Challenger Repts.
Rosa de Jericho, Hacienda	Matagalpa		over 3,300	over 1,006	17.2	63.0	14 mos.	1893–94	Niederlein, State of Nicaragua, Philadelphia Commercial Museums, 1898, p. 16–17.
Sabalos, Camp (on Rio S. Juan, 26 miles from Lake Nicaragua).	Chontales	11 2*		....	25.1	77.2	2	1898, 1900	(Same as for Greytown.)
San Carlos, Fuerte	Chontales	11 8*			25.7	78.3	1	1898–99	(Same as for Deseado.)
San Juan del Sur	Rivas	11 15*			25.1	77.2	1	1890	Bureau Amer. Repub. Handbook for Nicar. (Bull. 51) p. 19.
San Ubaldo	Chontales	11 51*	100	30	27.9	82.3	1	1900	Rep. U. S. Isthm. Canal Comm., 1899–1901, p. 343–4 (1904).
Sapoa	Rivas	11 15*	110	33	26.6	79.9	1	1900	Do.
Tola gage station	....do	11 25*			27.1	80.7	1	1900	Do.
Costa Rica.									
Aguacaliente	Cartago	9 50*	4,362	1,330	18.1	64.6	11 mos.	1889–90	Anales Inst. Fis. Geog. Nac. Costa Rica, II, p. 153–5. 1890.
Heredia	Heredia	10 0*			21.1	70.0	1	1868	Schott.
Puerto Limon	Limon	10 0*	10	3	25.4	77.7	1	1902	Bol. Inst. Fis. Geog. Costa Rica, II. 1902.
San Jose	S. Jose				21.7	71.1	11	1868–1878	Challenger Repts.
Do	....do	9 56	3,834	1,169	19.7	67.5	12	1889–1900	Bol. Inst. Fis. Geog. Costa Rica, I–III, 1901–1903; MWR, 1901; MZ, 1902, p. 273.
Turrialba	Cartago	9 55*	2,034	620	20.2	68.3	1	1894	Anales Inst. Fis. Geog. Nac. Costa Rica, VII, p. 65.
Zent	Limon		66	20	25.8	78.4	23 mos.	1902–3	Bol. Inst. Fis. Geog. Costa Rica, II, III, 1902–3.
Panama.									
Alhajuela (on upper Chagres River).			143	44	26.5	79.6	4.6	1900–1904	MWR, 1904, p. 267–72.
Boca, La (on Bay of Panama).					26.5	79.6	4.8	1899–1904	Do.
Colon (formerly Aspinwall)					26.2	79.1	5	1862–1868	Schott.
Do		9 22	164?	50?	26.4	79.5	8	1881–1888	MZ, 1895, p. 105–110.
Gamboa		9 10	102	31	25.8	78.4	6		Do.
Naos (island near Panama)		8 57	46	14	27.1	80.8	6½		Do.

† The original has 21.4, apparently an error.

the Tablas de Alturas por los Dres. Felix y Lenk in Anales del Ministerio de Fomento de la Republica Mexicana, Tomo XI, p. 363–456, Mexico, 1898, and in Boletin de la Sociedad de Geografia y Estadisticta de la Republica Mexicana for 1894, p. 207 et seq.

Where no determinations of latitude have been found in these authors, measurements of the approximate latitudes have been made from the maps of the Secretaria de Estado y del Despacho de Fomento (Comision Geografica de Guerra y Fomento. Carta de la Republica Mexicana, Escala 1:100 000) in many sheets,[2] the Carta General de la Republica Mexicana of Manuel Fernandez Leal, 1899; the maps of the Bureau of American Republics for Mexico (1900), Guatemala (1902), Nicaragua (1903), and Costa Rica (1903); those of the Century Atlas, New York, 1906; those accompanying Doctor Sapper's papers above quoted, and Rand, McNally & Co.'s maps for Mexico and Central America. All latitudes obtained in this way are marked with an asterisk (*).

A comparison of the preceding data shows that a given mean annual temperature reaches farther north and to a greater elevation on the Pacific than on the Atlantic slope of Mexico. Thus, the highest point on the Atlantic slope attained by the isotherm of 25° C. is Actopan, in Vera Cruz, 311 meters elevation, whence the isotherm descends to sea level south of Tuxpan, 20° 59′ N. On the Pacific side the same isotherm

[2] Many of these sheets have also furnished altitudes.

reaches 488 meters at Colima and, at no great elevation, to north of Culiacan (24° 48′ N.). The isotherm of 20° has its greatest elevations on the Atlantic side at Mirador, Vera Cruz, 1,000 meters, and at about 700 meters in Nuevo Leon, while on the Pacific side it reaches 1,560 meters at Oaxaca, and as much in Sonora. (Compare Magdalena.) Deprest portions of the central plateau have a higher mean annual temperature than less elevated points in nearly the same latitude on the Atlantic slope. (Compare Lerdo and Monterey.)

These remarks are suggested by the assertion by a recent zoological writer (Gadow, Proceedings Zoological Society of London, 1905, II, p. 196) of the existence of a much cooler climate on the Pacific side than on the Atlantic side of Mexico at almost the same elevation.

Records of mean monthly temperatures for a considerable number of other Mexican localities exist in literature (e. g. MWR 1896–1906; BOM 1888, 1889, 1895–1902, 1904; Anales, Ministerio de Fomento Repub. Mex. I, p. 649 et seq., IX, p. 329 et seq.; Barcena and Perez, Estudios de Meteorologia Comparada, Mexico, 1885, etc.), but these monthly records are not sufficiently numerous or continuous to permit of calculations of the mean annual temperatures of their respective stations.

A SMALL CLOUDBURST NEAR SHASTA, CALIFORNIA.

By R. H. McCANDLESS. Dated Calpella, Cal., February 10, 1908.

The article on "Cloudbursts," by Mr. Edward L. Wells, Section Director, Boise, Idaho, published in the Yearbook for 1906, suggests that the ruggedness of the country has to do with these special phenomena, which certainly are not tornadoes or waterspouts, properly so-called. In this connection I would state that during the winter of 1890 I lived in the town of Shasta, Cal., and put in much of the time prospecting in the vicinity. On one of these trips I came upon the opening of a steep and narrow, rocky ravine, down which had recently poured a tremendous flood of water. Ascending this ravine, I noticed that the leaves and bushes on its sides were covered with mud and grass roots, showing that the water must have had a depth of at least 30 feet as it came down the gulch.

At the upper end of the ravine, or gulch as it would be called by the local miners, and just below the crest of the ridge, I found a place approximately 50 feet square, where all the soil and loose stones were completely washed away, together with the bushes and one pine tree nearly two feet in diameter, just as would have been done by turning a huge stream of water upon it under heavy pressure. The pine had been carried some distance down the gulch.

Standing upon the spot and carefully regarding all the evidence in sight, I could form no other conclusion but that here, within the past few days, had fallen a veritable river from the clouds, leaving nothing where it fell except the hard bed rock.

I saw many similar denuded spots in the vicinity, but none of so recent a date as to leave any positive evidence of the manner of denudation.

All of these denuded spots occurred within two miles of the town of Shasta and on the eastern side of the low range of hills surrounding it on the west, northwest, and southwest.

LOCAL CHANGES OF CLIMATE.

By W. C. DEVEREAUX, Local Forecaster. Dated Milwaukee, Wis., February 12, 1908.

I was much interested in the short editorial on "Changes in climate" which appeared in the Wisconsin Agriculturist, of January 30, 1908. As this is a most interesting subject I have carefully examined the records of this office with a view of discovering what changes, if any, have occurred in the climate of Wisconsin, and especially in this part of the State.

The statement is frequently made that the winters in this vicinity are gradually becoming milder and that the snowfall is decreasing. Just about a year ago the temperature fell to 50° below zero at two places in the northern part of the State, and this low reading has not been surpast by any known record in Wisconsin. On the 28th of the following April there was a heavy snowfall over the northern part of the State, while at Milwaukee on January 28 of the present year, 16.0 inches of snow fell in twenty-four hours, which is the heaviest fall that has occurred since the records began in 1885; and the total fall for January, 1908, was 29.0 inches, which is the third largest fall on record for that month.

The precipitation record at Milwaukee for the past thirty-seven years shows that over 50 inches fell in 1876, while there were only 18 inches in 1901. This might lead one to hastily conclude that the rainfall is decreasing very rapidly, but there appears to be no great cause for alarm, for the precipitation since 1901 has varied only 1 per cent from the average for the thirty-seven years.

The temperature record since 1870 shows no appreciable change in the climate at this place, the mean temperature for 1907 being only 0.3° above the normal. The highest temperature at this station was 100° on July 16, 1887, and again on July 20, 1901, while the coldest days were January 9, 1875, with 25° below zero; January 5, 1884, with 24° below; February 9, 1899, with 22° below, and January 25, 1904, with 23° below. These extremes in temperature are well distributed thruout the period covered by the records.

In reference to the prevailing idea that the rainfall is increasing in the arid country, I have carefully examined the records of several hundred stations in the arid and semiarid regions along the eastern slope of the Rocky Mountains, and find that the precipitation for 1907 was not only decidedly less than the average for the four preceding years, but was about 10 per cent below the average for the last twenty or thirty years. From this it would hardly be safe to infer that the rainfall is decreasing in that region, neither is it correct to conclude that the rainfall is increasing after a few comparatively wet years.

As one of the newspapers in this city well said in a recent issue—

> The seasons are likely to succeed each other for a longer time in the future than any one alive is likely to survive. There will be seed time and harvest. There will be blustering Marches and showery Aprils, and balmy Junes, and torrid Julys and Augusts. There will be pleasant autumns and bleak Decembers, and there will be winter cold as well as summer heat—just as there was in the olden times * * *. In those olden times, as now, there were open winters now and then, and cool summers now and then. But they were exceptional. The general run of weather in this latitude can be depended upon * * *. The open winter of the present year has been open enough to let in plenty of cold wind from the north and northwest to insure the success of the ice crop.

The United States Weather Bureau is interested in making an authentic record of the climatic conditions of the country and in distinguishing between an apparent change in the climate and the variability of the weather. If an appreciable climatic change should be discovered, Prof. Willis L. Moore, Chief of the Weather Bureau, would be prompt in publishing the fact, but as he stated[1] before the Committee on Agriculture of the House of Representatives, at Washington, D. C.:

> It is my duty to publish the simple, ungarnished facts in regard to the climatic conditions of the United States. Our people want the truth so that they may not be misled either by those who honestly, but nevertheless ignorantly, claim that hot winds and droughts will never again come, or by those who, when periods of deficient rainfall occur, as they have in the past and as they certainly will in the future, preach discouragement and the abandoning of lands which, on the average of a long period of years, it would be profitable to cultivate.

[1] See Monthly Weather Review January, 1907, Vol. XXXV, p. 13.

ICE COLUMNS IN GRAVELLY SOIL.

By E. D. BOURNE. Dated Taylorsville, Ky., February 22, 1908.

In the MONTHLY WEATHER REVIEW for October, 1907, is a notice of an article on the formation of ice columns in gravelly soil, by Professor Goto, and the statement that an endeavor would be made to get a translation, or abstract of the same.

I have been interested, in an unscientific way, in this subject for years. About thirty years ago I noticed that occasionally a tiny column would shoot up above the general level of the group. Upon investigation I found that every one of these taller columns formed on a seed of horseweed (tall ragweed), and always on the end opposite to the germ end.

I have at various times made similar examinations and always found the same result.

POPOF AND ERMAN ON THE USE OF KITES IN METEOROLOGY.

In 1893 Professor Harrington took up the development of kite work in the Weather Bureau and during the years 1895, 1896, 1897 in successive numbers of the MONTHLY WEATHER REVIEW we publisht various historical references to those who advocated or used the kite as a means of sending aloft our meteorological apparatus. We now take pleasure in referring to still another instance that has lately come to our knowledge and that is eminently worthy of being added to the record. We allude to a memoir by Prof. A. Popof, of Moscow and Kazan, published in Russian in the Journal of the Minister of Public Education for September, 1846, but known to us only thru an abstract publisht in 1849 by Prof. A. Erman at p. 374–385 Vol. VII of his Archives of Science in Russia. Altho Professor Erman is most widely known by his important works in terrestrial magnetism yet his interest in climatology is shown by many articles in his archives and on every page of his Journey Around the Globe. His profound knowledge of dynamic meteorology is illustrated by his memoir of February, 1868, on the general circulation of the atmosphere publisht in Vol. LXX of the Astronomische Nachrichten.

In the present case Erman, writing in 1849, prefaces his abstract of Popof's memoir of 1846, by the remark:

> It is to be regretted that the paper kite which in Franklin's hands brought us such important conclusions as to the electricity of the atmosphere is now scracely noticed by physicists. By giving it a proper size this apparatus can, however, be applied with great advantage to the determination of the temperature, the wind direction, and the quantity of aqueous vapor in the upper strata of the atmosphere. Indeed for small altitudes it has some advantage over balloons, since kites stand for a long time almost immovable so that one can determine the altitude by other means than by angular measurements which take up much time and demand special apparatus. For such altitude determinations the equation of the curved line formed by the kite-string seems appropriate and therefore the mathematical expressions leading to this end will here be given, and the meteorologists will have to use these in order to determine the altitude of the kite itself or the altitude of any point on its string.
>
> Erman adds that if elastic springs be inserted in the kite line at the reel and again higher up say at the kite and records be made of the tensions at any moment then a simple formula will give the altitude of the upper spring.

We need hardly repeat the mathematical formulas of Popof, or Erman's improvements thereon; they may well be useful when the kites are not too high and the wind fairly uniform, but are not adapted to the irregularities of atmospheric currents and will not give the accuracy demanded in the modern practise of flying many kites tandem in order to attain the great altitudes that the Hargrave kite has now brought within our reach. It is interesting to reflect that if Professor Popof could have put his ideas into practical execution in Russia in 1846 meteorology might have gained fifty years over its present condition. As a rule, however, knowledge progresses by a system of irregular steps, first an idea, then an experiment; first the failure of an old theory then the starting of a new theory. Observation, experiment, hypothesis, philosophy, and theory follow each other in rapid succession. Mathematical seminaries, experimental laboratories, and observations under natural conditions must all be maintained. The progress of every branch of science as recorded in the literature of the last three hundred years shows an instructive series of failures and successes. The experiments of Alexander Wilson in 1749 were not repeated until the importance of upper air exploration was realized and until the students of the modern weather map perceived that long-range forecasts and even daily forecasts will never become satisfactory until we fully understand the upper currents and the general circulation of the atmosphere. It is to the study of this latter subject that kites and balloons, mountain stations and cloud observations are now essential, while the interpretation of the results needs the help of the best mathematical physicists.

It is often stated as a reproof to eminent philosophers that they are not "practical" that they "know" but can not "do." However, in the case of Popof, as of very many meteorologists, the money needed for practical work was not available and he could only mark out the methods and the paths for others to pursue. Fortunate is the "practical man" who has reliable theoretical men to guide him in the exploration of nature. The captain of a vessel would be hopelessly lost at sea if there was no navigating officer to show the course.—*C. A.*

FORECASTING ON THE PACIFIC COAST.

By Prof. ALEXANDER G. MCADIE. Dated San Francisco, Cal., February 4, 1908.

In an address delivered before the British Association in 1902, Prof. Arthur Schuster exprest the opinion that "meteorology might be advanced more rapidly if all routine observations were stopped for a period of five years, the energy of observers being concentrated on the discussion of the results already obtained." The accompanying article describes an attempt to partially meet the criticism by utilizing, for forecasting work on the Pacific coast, the charts published each month in the MONTHLY WEATHER REVIEW. No working meteorologist will fully agree with Doctor Schuster's opinion exprest above; yet the need of further study of the data now accumulated is evident and the limitations of our present methods manifest. And yet, has not too much been expected in the matter of forecasts. If not at the present time, certainly in the past, results have been expected entirely incommensurate with the facts and data furnished. Nor is there any present method of verification which does or can do full justice to the forecaster.

In recent years the recognition of the part played by the larger pressure areas, the so-called permanent and subpermanent continental and oceanic areas, has given the forecaster a possible means for undertaking seasonal forecasts with some prospect of success. The importance of extending the area of reports is now more than ever recognized. With the exception of the exploration of the upper air, the study of seasonal displacements of the areas of sea-level pressure offers the most promising field for helpful work in forecasting.

Over the Pacific Ocean, plainly, not less but more observations are needed. Absence of reports now handicaps the forecasters on the Asiatic as well as on the American side of the Pacific. It is conceivable that with a close working cooperation between the Japanese, Indian, Chinese, and Philippine weather services and those of Mexico and the United States, including Alaska and British Columbia, aided by the receipt of wireless weather messages from vessels at sea, the forecasting officials of these services would be in a position to undertake general forecasts for a period of a week or longer, eventually determining seasonal forecasts. And it may not be amiss to call attention to the excellent work done in forecasting on the Pacific coast, and to say that, valuable as the daily forecasts have been, the same degree of efficiency for

longer period forecasts would be of much greater value. The importance of seasonal forecasts for the Asiatic districts is widely recognized. It is not so generally known that there are well marked dry and wet periods in southern California and Arizona; and that some knowledge of the likelihood of abnormal conditions, especially dry winters, could be directly utilized by farmers and stockmen.

In this paper a description is given of a device, a glass map tray, which meets to some degree the requirements alluded to above: 1. Extending the area of reports. 2. Permitting comparison with typical conditions. 3. Permitting the study of of seasonal displacements of sea-level pressures. While the immediate problem was to bridge the Pacific Ocean, it appears that the method can be used advantageously in bridging the Atlantic. In the illustration (fig. 1, not reproduced) there is shown a series of glass maps for the month of January, 1908, covering the United States and extending eastward over the Atlantic and over Europe. In all an area of many million square miles is thus spread before the eye of the forecaster. A basic fact in meteorology, namely the general drift of the lower air from west to east is utilized in this device, by either moving each map a proper distance eastward every twenty-four hours or by moving a skeleton map of the United States an equivalent distance westward. The positions of high and low areas during and subsequent to their passage across the continent are thus shown. Forecasters on the Atlantic coast are enabled to follow the pressure areas long after these have past beyond the limits of land reports. Under the second requirement, comparison with typical conditions, fig. 1, shows a typical wet month, January, 1896. The sea-level isobars, isotherms, and resultant winds for any month, as charted in the MONTHLY WEATHER REVIEW, are thus instantly available for study. The normal pressure on the sea-level plane taken from the Report on Barometry can serve as a base for pressure departures; altho in the work at San Francisco where morning and evening forecasts are issued, it is necessary to use corrected normals. An enlarged portion of the frame is shown on fig. 2 (not reproduced).

TABLE 1—*San Francisco rainfall, monthly, seasonal, and annual, 1849–1907.*

Season.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March.	April.	May.	June.	Seasonal.	Year.	Annual.
1849–'50	0.00	0.00	0.00	3.14	8.66	6.20	8.34	1.77	4.53	0.46	0.00	0.00	33.10	1850	17.40
1850–'51	0.00	0.00	0.33	0.00	0.92	1.05	0.72	0.54	1.94	1.23	0.67	0.02	7.42	1851	15.60
1851–'52	0.00	0.02	1.03	0.21	2.12	7.10	0.58	0.14	6.68	0.26	0.32	0.00	18.46	1852	27.29
1852–'53	0.00	0.00	0.00	0.80	5.31	13.20	3.92	1.42	4.86	5.37	0.38	0.00	35.26	1853	21.17
1853–'54	0.00	0.04	0.46	0.12	2.28	2.32	3.88	8.04	3.51	3.12	0.02	0.08	23.87	1854	22.45
1854–'55	0.00	0.01	0.15	2.43	0.34	0.87	3.67	4.77	4.64	5.00	1.88	0.00	23.76	1855	26.39
1855–'56	0.00	0.00	0.00	0.00	0.67	5.76	9.40	0.50	1.60	2.94	0.76	0.03	21.66	1856	22.21
1856–'57	0.02	0.00	0.07	0.45	2.79	3.75	2.45	8.59	1.62	0.00	0.05	0.12	19.91	1857	20.96
1857–'58	0.00	0.05	0.00	0.93	3.01	4.14	4.36	1.83	5.55	1.55	0.34	0.05	21.81	1858	23.46
1858–'59	0.05	0.16	0.00	2.74	0.69	6.14	1.28	6.32	3.02	0.27	1.55	0.00	22.22	1859	21.39
1859–'60	0.00	0.02	0.03	0.05	7.28	1.57	1.64	1.60	3.99	3.14	2.86	0.09	22.27	1860	21.18
1860–'61	0.21	0.00	0.00	0.91	0.58	6.16	2.47	3.72	4.08	0.51	1.00	0.08	19.72	1861	25.52
1861–'62	0.00	0.00	0.02	0.00	4.10	9.54	24.36	7.53	2.20	0.73	0.74	0.05	49.27	1862	38.63
1862–'63	0.00	0.00	0.00	0.52	0.15	2.35	3.63	3.19	2.06	1.61	0.23	0.00	13.74	1863	15.10
1863–'64	0.00	0.00	0.03	0.00	2.55	1.80	1.83	0.00	1.52	1.57	0.78	0.00	10.08	1864	21.64
1864–'65	0.00	0.21	0.01	0.13	6.68	8.91	5.14	1.34	0.74	0.94	0.63	0.00	24.73	1865	14.06
1865–'66	0.00	0.00	0.24	0.26	4.19	0.58	10.88	2.12	3.04	0.12	1.46	0.04	22.93	1866	36.28
1866–'67	0.00	0.00	0.11	0.00	3.35	15.16	5.16	7.20	1.58	2.36	0.00	0.00	34.92	1867	30.64
1867–'68	0.00	0.00	0.04	0.20	3.41	10.69	9.50	6.13	6.30	2.31	0.03	0.23	38.84	1868	30.17
1868–'69	0.00	0.00	0.00	0.15	1.18	4.34	6.35	3.90	3.14	2.19	0.08	0.02	21.35	1869	22.59
1869–'70	0.00	0.00	0.12	1.29	1.19	4.31	3.89	4.78	2.00	1.53	0.20	0.00	19.31	1870	16.24
1870–'71	0.00	0.00	0.03	0.00	0.43	3.38	3.07	3.76	1.31	1.89	0.23	0.01	14.11	1871	27.53
1871–'72	0.00	0.02	0.00	0.07	2.81	14.36	4.00	6.90	1.59	0.81	0.18	0.04	30.78	1872	22.42
1872–'73	0.01	0.00	0.04	0.11	2.79	5.95	1.58	3.94	0.79	0.43	0.00	0.02	15.66	1873	18.56
1873–'74	0.01	0.08	0.00	0.83	1.16	9.72	5.66	2.21	3.36	0.90	0.66	0.14	24.73	1874	22.52
1874–'75	0.00	0.00	0.02	2.69	6.55	0.33	8.01	0.32	1.30	0.10	0.22	1.02	20.56	1875	22.63
1875–'76	0.00	0.00	0.00	0.24	7.27	4.15	7.55	4.92	5.49	1.29	0.24	0.04	31.19	1876	23.54
1876–'77	0.01	0.01	0.38	3.36	0.25	0.00	4.32	1.18	1.08	0.26	0.18	0.01	11.04	1877	11.93
1877–'78	0.02	0.00	0.00	0.65	1.57	2.66	11.97	12.52	4.56	1.06	0.16	0.01	35.18	1878	33.26
1878–'79	0.01	T.	0.55	1.27	0.57	0.58	3.52	4.90	8.75	1.89	2.35	0.05	24.44	1879	30.76
1879–'80	0.01	0.02	T.	0.78	4.03	4.46	2.23	1.87	2.08	10.06	1.12	0.00	26.66	1880	30.07
1880–'81	0.00	0.00	0.00	0.05	0.33	12.33	8.69	4.65	0.90	2.00	0.22	0.69	29.86	1881	23.73
1881–'82	0.00	0.00	0.25	0.54	1.94	3.85	1.68	2.96	3.45	1.22	0.21	0.04	16.14	1882	18.67
1882–'83	0.00	0.00	0.26	2.66	4.18	2.01	1.92	1.04	3.01	1.51	3.52	0.01	20.12	1883	15.48
1883–'84	0.00	0.00	0.42	1.48	1.60	0.92	3.94	6.65	8.24	6.33	0.23	2.57	32.38	1884	38.82
1884–'85	T.	0.04	0.33	2.55	0.26	7.68	2.53	0.30	1.01	3.17	0.04	0.19	18.10	1885	23.18
1885–'86	0.06	T.	0.11	0.72	10.06	4.99	7.42	0.24	2.07	5.28	0.37	0.01	31.33	1886	20.02
1886–'87	0.23	T.	0.01	1.48	0.84	2.07	1.90	2.24	0.84	2.30	0.06	0.07	19.04	1887	19.04
1887–'88	T.	0.01	0.29	T.	0.99	3.34	6.81	0.94	3.60	0.11	0.38	0.27	16.74	1888	23.03
1888–'89	0.01	0.01	0.98	0.13	3.99	5.80	1.28	0.72	7.78	0.96	2.17	0.03	23.86	1889	36.94
1889–'90	0.01	T.	T.	7.28	2.90	13.81	9.61	5.16	4.73	1.18	1.07	0.10	45.85	1890	25.43
1890–'91	0.02	0.00	0.31	0.00	0.00	3.25	0.98	7.26	1.96	2.44	1.25	0.11	17.58	1891	21.11
1891–'92	0.10	0.02	0.77	0.04	0.56	5.62	2.42	2.90	2.85	1.39	1.86	T.	18.53	1892	22.08
1892–'93	0.00	0.00	0.02	1.65	3.91	5.08	3.05	2.75	4.08	1.03	0.15	0.03	21.75	1893	17.91
1893–'94	0.02	0.00	0.21	0.16	4.18	2.25	5.99	2.69	0.60	0.50	1.31	0.56	18.47	1894	24.32
1894–'95	T.	0.00	1.05	1.73	0.88	9.01	6.99	2.31	1.89	1.24	0.60	0.00	25.70	1895	17.13
1895–'96	0.01	0.00	0.77	0.11	1.78	1.43	8.14	0.28	2.85	5.16	0.72	0.00	21.25	1896	28.25
1896–'97	0.04	0.09	0.52	1.55	4.56	4.34	2.26	4.41	4.56	0.27	0.61	0.22	23.43	1897	16.40
1897–'98	T.	T.	0.10	1.70	1.05	1.22	1.12	2.13	0.24	0.19	1.44	0.19	9.38	1898	9.31
1898–'99	0.00	T.	1.06	0.86	0.46	1.62	3.67	0.10	7.61	0.62	0.86	0.01	16.87	1899	23.23
1899–'1900	0.00	T.	0.00	3.92	3.79	2.65	4.11	0.64	1.91	1.08	0.32	0.05	18.47	1900	15.33
1900–'01	T.	T.	0.46	1.48	3.91	1.37	5.79	5.03	0.80	1.64	0.69	T.	21.17	1901	19.75
1901–'02	T.	T.	0.78	0.64	3.48	0.90	1.23	7.27	2.65	0.98	1.05	T.	18.98	1902	19.18
1902–'03	T.	T.	T.	1.70	1.98	2.32	3.73	1.76	6.23	0.56	T.	T.	18.28	1903	18.33
1903–'04	0.00	T.	T.	0.17	4.25	1.63	1.05	5.89	6.01	1.29	0.30	T.	20.59	1904	24.72
1904–'05	0.02	0.06	5.07	2.37	1.07	1.59	4.04	2.70	3.15	1.33	2.05	0.00	23.45	1905	16.24
1905–'06	0.00	T.	T.	T.	0.92	2.05	3.90	4.30	5.02	0.92	2.75	0.56	20.42	1906	26.34
1906–'07	0.08	0.11	0.18	0.03	1.59	6.90	4.41	3.02	8.42	0.11	0.04	1.28	26.17	1907	....
Average (58 years)	0.02	0.02	0.30	1.02	2.66	4.68	4.72	3.54	3.37	1.74	0.75	0.16	22.98	....	22.77

The third requirement, that of quick recognition of seasonal pressure displacement, is met in the following manner: Records of many years are assembled. Rainfall tables embracing a period of nearly sixty years are prepared for at least three stations in California (e. g., Table 1, San Francisco rainfall, 1849–1907). While these printed tables give only the intensity or amount of precipitation, auxiliary tables give the frequency, or number of rainy days. Thus the forecaster has a ready reference table of wet and dry months. He has also that which is of more value, viz, abnormal periods, or months when there was little rain and months of excessive rain during winter. He can also refer quickly to months of excessive rain during the normally dry period. Confining the discussion for the present to a single month (e. g., January) it is seen that for the central portion of California there have been seven abnormally dry periods in the heart of the wet

season; namely, in 1851, 1852, 1889, 1891, 1898, 1902, and 1904. For some of these we have the monthly charts of isobars available, and by making a composite we can formulate the following general laws for forecasting:

A. When the continental high overlies Oregon, Idaho, Utah and Nevada, the general drift of the surface air is from the north or northeast; and such a circulation favors fair weather, with little precipitation. Individual highs are likely to move slowly eastward. Individual lows are restricted to northern counties, and pass as a rule eastward without extending southward.

From the nine abnormally wet seasons, viz., 1850, 1856, 1862, 1866, 1875, 1877, 1881, 1890, and 1896, we learn, using such charts of the MONTHLY WEATHER REVIEW as are available, that—

B. When the north Pacific low area extends well southward along the Oregon coast and the continental high overlies Assiniboia and Montana, the general drift of the surface air in California is from the south or southeast. Conditions favor unsettled weather, with frequent and heavy rains west of the Sierra and heavy snowfall in the Sierra. Individual highs appear with little warning north and east of the Kootenai, and move as a rule slowly south. Individual lows appearing over Vancouver Island and the north coast of Washington, deepen and also extend southward, the rain area reaching northern California in twelve hours, the central coast in twenty-four hours, and the coast south of Point Conception in thirty-six hours.

Combining A and B we can estimate the relative change in pressure and air movement for a given increase of precipitation. If records of duration of cloudiness and rain were available, some relation might be found between the direction and strength of surface winds, and duration of rain.

Taking up the abnormal periods for February, we find some notably dry months, e. g., 1864, when the entire month was without rain; 1850, 1852, 1856, 1886, each with four rainy days; 1875 and 1883, with three rainy days, and 1889, with but two rainy days. Other dry Februaries were 1885, 1896, and 1900. We have no records for 1864; but we feel able because of these studies to chart the probable pressure distribution for that month; namely, unusually high pressure over Idaho, Oregon, and Washington, with surface winds from the north and east.

With regard to wet periods, we find that the following Februaries were abnormally wet, 1854, 1857, 1859, 1862, 1867, 1878, 1887, 1891, 1902.

If we consider the number of rainy days, rather than the amount of rain, we have the following as abnormally wet Februaries: 1854 (16 days), 1857 (15 days), 1859 (18 days), 1872 (17 days), 1873 (17 days), 1878 (19 days), 1887 (16 days), 1891 (19 days), 1897 (17 days), 1902 (19 days), 1904 (16 days).

Composites of these confirm the law given above under B.

As illustrative of the difference in the amount of rain falling in a dry and a wet month, we give the isohyets for California for January, 1902—a dry winter month; and for February, 1902—a wet winter month (see Charts IX and X).

For the dry month there was an estimated deficiency, determined from normals for 194 stations, of 81 millimeters (3.17 inches) or approximately 35,755 million tons of water.

For the wet month, the excess of precipitation was 131 millimeters (5.17 inches) or 58,320 million tons of water.

* * * * * * * *

California offers exceptionally good opportunities for studying seasonal variations and climatic abnormalities. Supplementing the comparatively brief record of nearly sixty years, we have meager records of extremely dry periods noted by the failure of crops during the time when the Mission Fathers controlled agricultural and stock interests. There was, for example, a failure of the crops at all of the missions in 1829, and we naturally infer that there was a period of drought in the winter months. It is an interesting fact, but whether a coincident or not we do not say, that a drought period occurred in 1863–64, or at a time corresponding to the Brückner 35-year period. Again, after nearly the same interval we have another drought period 1897–98. Crop yields, however, are influenced by many other factors than that of rainfall.

In California there is a growth of Sequoia, both *sempervirens* and *gigantea*, where rings of annual growth may be traced for periods extending in some cases to nearly three thousand years. In these rings we have to some degree an integrated history of the seasons and possibly the periods of extreme drought and excessive rainfall could be determined. The tree, however, is not a ready witness and the study, when made, must be entrusted to careful and competent hands.

In communicating the preceding paper, which is printed by special order of the Chief of Bureau, Prof. Alexander G. McAdie, says:

"As the paper touches upon the possibility of seasonal forecasts on the Pacific coast, or rather upon forecasts for periods of ten days, or longer, I would appreciate a personal reading by the Chief of the Weather Bureau and an expression of opinion from him, as well as any comment or criticism which my colleagues in the Forecast Division may care to make."

Accordingly the following remarks are appended:

While it is far from true that conditions of pressure and temperature presented by a map of one day will represent conditions that will exist 15°, more or less, to the eastward on the following day, yet the tracings on glass are, in a measure, useful. The paper, as a whole is interesting, and its publication is recommended.—*E. B. G.*

As yet I am very skeptical as to the possibility of extending our period of forecasting effectively, chiefly, as stated by Professor Henry, because of the want of persistence of any well-defined type of pressure distribution, and because of the comparative uncertainty as to the direction of movement of areas of high and low pressure, even for twenty-four hours in advance. However, I think Professor McAdie's paper a very interesting one, and of value that will fully justify its publication.—*H. C. F.*

The relation of the pressure distribution for several months to the weather for the corresponding period has been a fruitfull subject of discussion for some years. The work by Hildebrandsson, de Bort, and Hann, in Europe, is well known. These scientists have shown that the weather of northwestern Europe is related in a general way to the pressure distribution over the Azores and in the vicinity of Iceland, respectively.

The author of the paper now under consideration calls attention to the apparent connection between the monthly pressure distribution on the Pacific coast and the rainfall; also to a device for projecting the current distribution of pressure forward over 15° of longitude, and discusses the utility of this device in forecasting.

That the weather experienced from day to day depends almost wholly upon the pressure distribution goes without saying, but when an attempt is made to apply the knowledge thus far gained as to the influence of the so-called permanent and subpermanent continental and oceanic areas on the weather of both adjacent and somewhat remote regions, the same difficulties are met that are encountered in the twenty-four hour forecasts, viz, the inability of the forecaster to fix, with any degree of certainty, the time that a condition once establisht will persist. I speak now more especially of the so-called continental areas of high pressure and forecasting in the United States. The movement of highs and lows in this country, especially in the cold season, is far too rapid to permit of the formation of areas of either high pressure or low pressure that can properly be called even subpermanent.

Even the so-called "Plateau high," an area of high pressure that occasionally lodges over the Great Basin in winter, does not persist on the average over two or three days. There are times, of course, when it persists for a longer period, but on these occasions it is believed that the endurance beyond the average period is due to the inflow of cold air from the northwest. In other words, the Great Basin, owing to the topographic surroundings, actually serves as a basin or reservoir in which part of the cold air which has a slow eastward or southward motion is entrapped.

One of the reasons for entertaining this view is the fact that offshoots from the "Plateau high" are frequently discharged to the eastward or southeastward. After the discharge of an offshoot the parent high soon disintegrates It is also believed that owing to local radiation, and the drainage of cold air into the valleys occupied by Weather Bureau stations, the sea-level pressures for the Plateau region, are at times greatly affected by these local surface temperature falls.

An area of high pressure *firmly lodged* over the Great Basin is a most important asset to the forecaster, not only on the Pacific slope, but eastward from the Rocky Mountains including the Northern and Central States.

As I said before, according to my experience, there is no distinct pressure formation in this country that approaches a condition of subpermanency. There are times when the highs and lows follow each other in nearly the same path. When this condition prevails it is customary to say that a certain type prevails. The same phenomenon has been observed in Europe: See Nils Ekholm in the January, 1907, Meteorologische Zeitschrift, "Über die Unperiodische Luftdruckschwankungen und einige damit zusammenhängende Erscheinungen." (On the nonperiodic pressure variations and some phenomena in connection therewith.)

It seems to me that it would be profitable to study the daily weather maps in periods of less than a month since the latter period is too apt to include the records of more than one type. It might be possible to do this for the Pacific coast where the atmospheric movements are less complicated than in eastern districts.

As an illustration of what one would meet in attempting to correlate monthly mean pressures and weather conditions, I submit, herewith, copies of the monthly mean pressures for March, for the years 1902 to 1906, together with the paths of highs and lows on the Pacific coast and over the Plateau region. But one of these months (March, 1904) shows a steadiness in the movement of lows that would be useful to the forecaster. (Charts XI to XV.)

Aside from the forecasting point of view considerable interest attaches to this subject on account of its bearing upon a rational explanation of climate. In this connection see Bulletin Q, under "Seasonal variations of the weather."

In regard to Professor McAdie's second proposition, I would say that we are never certain that the pressure distribution and the weather conditions existing at any moment of time will match the actual conditions to the eastward in the next twenty-four hours.—*A. J. H.*

CAN WE PROTECT AGAINST TORNADOES?

A well-constructed conductor is a fairly reliable protection against destruction by lightning, but one must be inside the protected building, as there is no assurance of safety on the outside. A dwelling *may* be so constructed as to pass uninjured thru a hurricane, tornado, earthquake, flood, or fire, tho it is rare that such are built, and that which is safe against one kind of visitation may not be so for another.

The following correspondence shows one phase of the question of protection. We should like to have some one compile enough data to give us a fairly correct idea as to whether it is best to be frightened at every storm cloud and run to the shelter of the "tornado cave," or whether we may not as well be brave and calmly await the dread visitation, since it is most likely to pass us by. As the result of his extensive studies Lieut. John P. Finley maintained that the best we can do is to watch the distant tornado, and if it seems to approach us then move away toward the left; so far as we have learned, this still continues to be the best rule.

(1) LETTER FROM A CORRESPONDENT TO THE CHIEF OF BUREAU.

I am going to establish in this city a system which will give us warning of the approach of tornadoes, which is as follows:

We will run a pole line around our city at a distance of four miles, which is connected to an alarm in the city by wires, using the very best of wire and putting up the line in the most substantial manner. There will be two wires on this circuit around the town. We will place instruments a quarter of a mile apart on this line, to be adjusted to short-circuit the wires by making an electric contact, should a change in the atmosphere pressure (of as much as three-tenths of an inch) take place within five minutes.

The magnetic apparatus for giving an alarm in the city is arranged so that if one or both the wires are broken it will cause an alarm to be given, or should the wires touch one another by being twisted together it would give an alarm; also should the instrument short-circuit the wires by the sudden change in the air pressure, we would receive an alarm. We will have notice in advance of the tornado by the time it would take it to travel from the instrument or pole line to the city, and as the line is all around the city, at a distance of four miles, it would be unable to reach the city from any direction without giving us an alarm.

I have kept in touch with the great work that your Bureau is doing under your able management, and I earnestly hope that you and your good workers may live to quite an old age, as you have done much to overcome ignorance and superstition in regard to the many fake ideas of the people in regard to forecasting the weather.

REPLY TO THE ABOVE LETTER BY THE EDITOR.

You propose to surround your city by a double line of telegraph wire inclosing an area about 8 miles in diameter or 25 miles in circumference. At every quarter mile of this circumference (100 stations in all) you will place an apparatus that will automatically short-circuit the line whenever the atmospheric pressure rises or falls at the rate of three-tenths of an inch in five minutes, or faster. The wires will also be short-circuited, or an alarm given, if either wire is broken or if the wires touch each other. You think that this system of alarms will protect the city from the unexpected arrival of a tornado.

The statistics of tornado frequency show that a region of 1 square mile any where in Missouri is not very apt to experience a tornado, the probability being one-sixteenth of one per cent per century, so that a region 4 miles square would have a probability of 1 per cent per century; that is to say, it will presumably have a tornado once in ten thousand years. It is therefore probable that your system of wires and apparatus would have to be kept in working order many years before it could be of use; and unless it be kept in perfect repair, at great expense, it will be out of order and useless when the tornado comes. For these reasons many schemes analogous to yours which have been proposed in the last forty years have been abandoned as impracticable. If you have any statistics showing that tornadoes are specially frequent in the neighborhood of .... I should be glad to receive them and revise this calculation.

You state that you are going to establish your system around ....; does this mean that you are going to do it at the expense of the city, or as a private enterprise?

(3) SECOND LETTER FROM A CORRESPONDENT.

In reply to your letter, I will say that I am unable to give you any additional information in regard to the frequency of tornadoes in this State, for the following reasons:

1. That most newspapers, as well as the public in general, call tornadoes "cyclones."
2. I have only been able to visit a few of the damaging storms to ascertain what they were.
3. That I believe that only a small per cent of the tornadoes reach the earth's surface, and it seems to me that it would be difficult on this account to ascertain or even attempt to approximate the number of tornadoes in any locality.

I quite agree with you that it is only a small per cent of tornadoes that do damage in this State, but there are so many dark, dangerous, and threatening-looking clouds that we will be uneasy, and this will cause us to always keep our alarm system in the best of condition for fear that they are tornadoes.

I have only this one life to live, and being healthy and enjoying it there is no expense I would not undergo to protect it, as I prefer living to any other state or condition I can imagine. We will not install this

alarm system because we want frequent tornadoes, but quite on the contrary because we do not, but want to be forewarned when there is one.

The Weather Bureau officials deserve credit for the work that they have done in giving us facts and figures to work from, as well as the many wonderful discoveries they have made. They have taken an uneducated people which had all kinds of superstitious ideas in regard to foretelling the pending weather, based on myths and old traditions, until after a process of evolution and hard work on their part we have now a Weather Bureau superior to any in the world. They educated themselves while educating the masses until they have reached this state of proficiency. All this has been accomplished within the last forty years, and if these same persons are kept in charge of this work, I believe our Bureau will advance as much within the same time in the future. While there is life there is room for progress.

I have read your articles in the WEATHER REVIEW and have gained much information in regard to lows and highs and the conditions accompanying them, and it seems to me that there is not much work left undone. I also read what you write with special interest, because it impresses me that you are dealing with facts as you find them regardless of what theory they may upset or uphold; like all true scientists, you are seeking the truth.

I am only a beginner, and any suggestions and information that you will kindly give will be appreciated. I am open to conviction and believe that we all should so school ourselves as to be able at the end of each period to slough off the skin of preference or prejudice that may have hardened itself around us during the last period.

(4) REPLY SENT TO SECOND LETTER BY EDITOR.

In reply to yours of July 27 I may thank you for saying that the Weather Bureau deserves credit for the work it has done in giving facts and figures, and educating the people above superstitions and errors in regard to the weather; but our efforts to benefit the people will be in vain if, in spite of our facts and figures, you create an unnecessery dread or fright with regard to tornadoes in your locality. I see no reason to believe that your system of telegraph line and automatic signals will give any reliable forewarning of a tornado; and should advise you and the city not to waste money on it. You state your belief that only a small per cent of tornadoes do damage at the earth's surface, in your State, and the rest do not reach the ground. You also add that you can not give any additional information about tornadoes, because the public generally call them *cyclones*. Neither of these ideas is true; the use of two terms, "tornado" and "cyclone," need not produce any confusion in the statistics of frequency. The tornadoes that do damage at the earth's surface are the only ones that need to be counted in any efforts that you make to provide against them; and, as I wrote before, *these* are so rare that a region four miles square need not expect to have more than one in ten thousand years. If you count every destructive wind and every imaginary tornado far above the ground in the dark and threatening clouds as a proper reason for fright and anxiety, you will produce a wholly unnecessary state of uneasiness and alarm in the community.

You say there is no expense you would not undergo to protect your life, but you do not protect it efficiently by your telegraph line and forewarnings of tornadoes. The chance of your dying from a tornado is not the ten-thousandth part of your chance of dying from disease, accident, lightning, etc., and it would be a wiser policy to spend your money to protect yourself against these. The mere forewarning of a tornado is no protection against its coming.

THE OBSERVATORY ON MOUNT ETNA.

Under date of May 16, 1907, at Messina, Sicily, Prof. G. B. Rizzo, the director of the observatory recently built near the summit of Mount Etna, wrote that he was about to start for the summit and to occupy the observatory there for the summer, where he would make a series of observations on the intensity of solar radiation, as measured by means of the Ångström pyrheliometer. This instrument is a duplicate of that which has been used for the past five years by Mr. H. H. Kimball, and on account of the special interest taken in this subject by American students Professor Rizzo proposes to communicate his results for publication in the MONTHLY WEATHER REVIEW.

The importance of continuous meteorological work on mountain summits is felt more and more as our knowledge of meteorology progresses. The balloon work and kite work must be supplemented by regular mountain stations; these latter are practicable and inexpensive where balloon work would be impracticable. There are many noble peaks on ocean islands that still remain to be occupied, and even if they can not be occupied immediately, yet the cloud phenomena about their summits should be systematically observed.

The following description of the ascent of Mount Etna is abbreviated from an account by Maj. Albert Woodcock, formerly United States Consul at Catania, Sicily, whose letter was published in the Sportsman Tourist, Vol. LXI, New York, July 25, 1903, which contains much interesting information, but we have omitted that which is not appropriate to the MONTHLY WEATHER REVIEW.

At 3 o'clock a. m. of August 14 last (1886), a large carriage drawn by two stout horses left Catania to make the ascent of Mount Etna and the descent into Val del Bove. A hammock beneath the carriage and a boot at the rear contained blankets, rugs, overcoats, and rations for a two days' campaign. We were soon looking down upon Catania with its thousands of lights, and upon the beautiful sea.

The moon was at its full. As we ascended the air grew fresher and more bracing; it had been uncomfortably warm in Catania when we left. We were ascending thru a highly cultivated region. Orchards of orange, lemon, almond, and fig and vineyards of grape grow luxuriantly upon the slopes. In an hour and a half we had ascended to Gravina, an unimportant village of low, lava-constructed houses. Two miles higher up we reached the quaint old town of Mascalucia. Perched high up on the side of Mount Etna, it commands fine views of the sea and landscape below. There twilight commenced to steal upon us, and the morning star that had glowed with unusual brilliancy above the Calabrian peaks began to pale. Still higher up we reached the lava village of Torredi Grifo. We were now above the orange belt. In this high altitude in winter are heavy frosts and frequent snows. We now entered upon a barren waste of lava bed, which marks the eruption of 1527.

We arrived at Nicolosi, 2,265 feet above the sea, at 6 o'clock, a. m. Nicolosi is an earthquake-riven town, and has several times been shaken to the ground. The lava flood of May last approached within 1,000 feet of it. It there stands a black, hideous mass, still hot and sending off sulphurous vapors. We rested at Nicolosi for an hour, refreshing ourselves with cold coffee, bread, and cheese.

Signor Orazio Silvestri, professor of chemistry, geology, and mineralogy of the Royal University of Catania, courteously tendered us the use of the observatory. The direct road of ascent is covered by the lava flood of May last from 20 to a 100 feet deep. We were obliged to make a detour around this hideous field of black desolation. We flanked Monti Rossi (the Red Mountains) on the south.

Soon after leaving the Red Mountains, we came to a spur of the lava bed of May last. It was insufferably hot. Our mules quickened their pace in crossing. We had left the cultivated region at Nicolosi and were now entering the wooded belt. The trees were mostly of a young growth of chestnuts. Wood being in great demand, the trees were cut before they reach the ordinary size. In this same wooded region, however, on the west side of Mount Etna, there are several monarchs of the forest that have escaped the woodman's ax. They are said to be the oldest trees living and are without doubt 1,000 years old.

Our ascent was very slow and tiresome to the mules. The last May eruption had covered the ground with volcanic sand. The trees seemed to rise from a black sandy desert, there being no green thing visible but their ramage. We reached Casa del Bosco (House of the Woods) at 10 o'clock a. m., tired and voraciously hungry. We were now at an altitude of 4,216 feet above the sea. Casa del Bosco is the last resting place before the final climb to the summit.

The ascent became steeper and more difficult. We wound around the east side of Mount Castello and ascended between Monti Agnuolo and Frumento. We were above the habitable zone. All appearances of vegetation had ceased. No bird fluttered by us, no cricket chirped. There were no signs of animal or insect life. All about us was black desolation. Sun-lit clouds were hanging upon the crests below us. Our way was over black volcanic sand and loose boulders of lava. We were soon upon Piano del Lago (the plains of the lake). Lava floods have filled it, and it has ceased to be a lake.

Casa Inglese is 9,652 feet above the sea. It is situated at the base of the great cone. It was erected in 1811 by some officers of the British Army; the English at that time occupied Sicily. It is a low one-story building, constructed of lava rock, and stands east and west; in one of the three rooms is a fireplace. This building is the refuge of excursionists to Etna. The observatory now (1886) is a low two-story building surmounted by a dome. It is built of lava rocks, the walls being of unusual thickness, to withstand the frequent shocks of earthquake. It is joined to Casa Inglese, the latter being a lean-to on the south to the former. A telescope and all other instruments requisite for making observations in astronomy, meteorology, etc., have been purchased and will soon be mounted in the building. Owing to the kindness of Professor Silvestri (as before stated) we were in possession of the observatory. Here we found beds, bedding, table, chairs, etc., designed for the use of the scientists; these, for the time being, were ours, and we were supremely comfortable. After an hour's rest our company mustered for the ascent of the great cone. It towered into the heavens 1,200 feet above us, its sides being very steep.

We finally reached the north rim of the crater. The grand old sea and the Calabrian peaks lay outstretched before us. Sun-lit clouds in great

billows were floating below us. These, tho wonderfully beautiful, dyed in the rich colors of the declining sun, shut off the greater portion of the island from our view. On my previous visit to Etna, in May, 1884, the atmosphere was much clearer. Then we could see the greater part of the island. The entire east coast was outstretched below us. The billows of the sea breaking upon the rocky coast gave it a silvery edging. Two cities and a vast number of villages and hamlets incrusted the seashore, dotted the valleys, and nestled on the hillside. The Sicilian Mountain chains rose about us in great irregular ridges, crest peeping over crest. Stromboli to the north (seemingly but a stone's throw away), protruded his rocky head and shoulders above the sea. He was throwing a dense column of black smoke thousands of feet into the heavens. Adjacent was the little island volcano throwing upward white puffs of clouds. Mount Etna at the same time was shooting upward an immense column of sulphurous steam, rendering it impossible to see much of the interior of the crater. An inky black cloud hung below us at the west. From it came zig-zag chains of lightning flashes and thunder peals. We looked down upon the storm; it was raining below us, but we were in the sunshine above.

When the heavens are free of clouds the whole island, with its innumerable mountain peaks, is visible from the rim of the crater. With a glass the waves of the sea may be seen breaking in foam upon the rocky coast of the entire island. Malta is visible in the south, Stromboli and the Lipari Islands to the north, the Aegedian Islands to the west, and the three great seas of the Mediterranean—the Ionian, the African, and the Tyrrhian.

The sun was low down in the west and seemed to swim in a sea of glory. A stratus of clouds lay low in the heavens shutting off all view from the west. The stratus did not resemble clouds, but looked like a vast sea flecked with gold by the setting sun. As the sun neared the western horizon, it cast a great purple shadow of Etna against the eastern sky. It was triangular shaped and seemed to hang vertically in the heavens. For a time the rising moon shone with its silver light in the very apex of the purple pyramid. It was the strangest and most beautiful scene my eyes ever beheld.

DUSTFALL IN IDAHO.

Under date of April 18, 1908, Mr. F. Roch, the special observer of Wallace, Idaho, writes:

> Twice within the past ten days we have had rainfalls so heavily charged with dust—the dust in dry form falling in flakes the size of a pinhead—that they might be called dustfalls instead of rain. These specks of dust came down as straight as it would be possible for a gentle rain to fall, and the fall continued for several hours intermittently.

This large quantity of dust must have had a special origin nearby and we hope that Mr. Roch will trace it to its source.—EDITOR.

METEOROLOGICAL EDUCATION.

In connection with the statistics of educational work by Weather Bureau officials, the editor would be glad to know of stations at which such work could be done more satisfactorily than now if some one especially fitted as teacher were attached to the local office force. Of course the teaching is only a small part of the official work, but it is well to have it done creditably to the Bureau. The subject is really so important and so interesting that we think colleges and academies will certainly take pride in being pioneers in the work.—EDITOR.

THE LAW OF THE EARTH'S NOCTURNAL COOLING.

By Prof. WILLIAM H. JACKSON. Dated Haverford College, Haverford, Pa., May 13, 1908.

In 1872 A. Weilenmann[1] showed that the normal temperature curve from sunset to sunrise may be represented by a formula appropriate to the Newtonian rate of cooling, that is by

$$\theta = \theta_0 + C\,b^t \quad \ldots\ldots (1)$$

where t denotes the time measured in hours from midnight, θ the temperatures at time t, and θ_0, C, b are constants chosen to fit the observations as well as possible. Further, he found the striking agreement between the values of b for different places, as shown in the following table:

[1] Ueber den täglichen Gang der Temperatur in Bern. Schweizerische Meteorologische Beobachtungen. Band IX. 1872.

TABLE 1.—*Values of b for different places.*

Place.	Log b.	Duration of observations, in years.
Hobarton	$\bar{1}.934$	8
Berne	$\bar{1}.935$	7
Great St. Bernard	$\bar{1}.936$	19
St. Petersburg	$\bar{1}.938$	16
Ghent	$\bar{1}.939$	24
Prague	$\bar{1}.939$	13
Toronto	$\bar{1}.940$	6
Batavia	$\bar{1}.942$	3

In 1888 M. Alfred Angot[2] found that the corresponding values of log b for St. Maur, near Paris, were $\bar{1}.940$ for clear nights and $\bar{1}.936$ for cloudy nights. This is an independent confirmation of Weilenmann's results, and seems to show what might perhaps be inferred from those previous results, that the value of b is practically independent of the state of the atmosphere.

I was informed of these facts early in 1906, when Prof. Arthur Schuster drew my attention to a paper by Dr. S. Tetsu Tamura,[3] which gives an excellent account of the whole subject. At the same time he suggested that the facts could probably be explained by supposing that the earth radiated like a black body and that the question might be treated as one of heat conduction.

Attempts to treat the matter theoretically only led to two negative conclusions. First: It is unlikely that such a law can represent the actual facts, because such a law implies a solution of the differential equations to be solved of the form

$$\theta = f(x)\,e^{-kt},$$

where x denotes the distance from the surface of the earth. Such a law as this implies that all temperatures are decreasing at the same rate; whereas we know that the relative temperatures of the earth and atmosphere vary considerably in the course of the night. Secondly: If such a law represented the state of affairs, the coefficient b would vary from place to place, according to the nature of the ground.

Or we may look at the question from a purely theoretical point of view. Following Riemann,[4] the solution of the problem of the cooling of a very large conducting sphere, originally everywhere at unit temperature, and radiating heat into space at a rate proportional to the constant h, allows the surface temperature to be exprest by the formula,

$$\theta = 2\pi^{-\frac{1}{2}} h e^{a^2h^2t} \int_{a\sqrt{t}}^{\infty} e^{-h^2s^2}\,ds \quad \ldots\ldots (2)$$

where a is the diffusivity of the sphere. Extending this formula to the case of a sphere normally in a steady state of heat flow, but which has been subjected to a uniform increase of temperature, and which is then left to return to its original normal condition, we obtain the series,

$$\theta = \theta_0 + \theta'\left(1 - 2\pi^{-\frac{1}{2}} aht^{\frac{1}{2}} + a^2h^2t + \tfrac{4}{3}\pi^{-\frac{1}{2}} a^3h^3t^{\frac{3}{2}} + \ldots\ldots\right) \ldots (3)$$

To obtain a more approximate solution for the actual case of the earth, we should of course suppose that the disturbance from the normal state was not a uniform increase of temperature, but a complicated function, decreasing as the distance below the surface of the earth increases. I have not thought it worth while to attempt this, because as explained, later, I believe the problem is best attacked by other methods.

[2] Influence de la Nébulosité sur la variation diurne de la température à Paris. Annales du Bureau Central. 1888.

[3] Mathematical Theory of Nocturnal Cooling of Atmosphere. Monthly Weather Review, April, 1905.

[4] Partielle Differentialgleichungen und deren Anwendung auf physikalische Fragen. Par. 69, 3d Edit. 1882. The same result is obtained by a different method by Carslaw, Fourier's Series and Integrals. 1906. P. 246.

It seemed possible that the first objection might be reconciled with existing knowledge, if the exponential curve were not the only one which could fit the temperatures considered. It might well happen that another curve of the same general shape, e. g., a parabola with its axis vertical, would fit the results just as well. In fact, taking Weilenmann's figures for Berne for the month of January, we have

$$\theta = -3.79 + 0.98e^{-.17t}.$$

This is the most unfavorable case in every respect, for the value of log b is very small (1.925), and the maximum value of t is large, i. e., 7. Supposing now that the right-hand side be exprest in powers of t, we have

$$\theta = -2.81 - 0.17t + 0.015t^2 - 0.0008t^3 + \ldots.$$

The maximum value of this last term amounts to a tenth of a degree. But it can easily be seen that this is greater than the errors that would result in using a three term formula, like

$$\theta = a_0 + a_1t + a_2t^2 \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

because the values of the a_0, a_1, a_2, would not be exactly the same as in the previous series, but would be altered in order to compensate for the omission of the final term. It is to be observed that equation (4) contains exactly the same number of arbitrary constants as equation (1), and that equation (4) is an expansion in Maclaurin's series. It is the natural form to be assumed for approximations to a slowly varying function. Any region which is sufficiently narrow to give good results when only the first three terms of this series are used, should give equally good results if equation (1) is used. In fact, provided the complete Maclaurin series has alternating terms which decrease in the same general way, as the exponential series, equation (1) should give better results than equation (4), but would not necessarily on that account have any real physical significance.

Still, no light was thrown on the second difficulty; the constancy of the coefficients calculated by Weilenmann. They varied widely from month to month, but the yearly average gave fairly constant results. With regard to this difficulty, it should be remarked that the constancy is not quite so great as at first appears; for, supposing that the constant b is very nearly equal to 1, a more satisfactory method is to write $b = e^{-h}$, and deal with the value h, which would be the quantity dealt with in a theoretical investigation. Going back to Table 1, the values for log b vary from 1.934 to 1.942, i. e., from −0.066 to −0.058, a variation of 13 per cent; whereas, the variation in the value of b, from 0.859 to 0.875, is less than 2 per cent. Both of these variations are probably small in comparison with the change in the average diffusivity of the earth's surface layers. The matter rested thus until a few months ago, when, by the very kind assistance of Prof. Cleveland Abbe, I was enabled to test the original evidence on which the law was based.

The first result of this examination has been to show that the exponential formula gave only slightly better results, on the whole, than the parabolic formula—as was to have been expected from the nature of the case. The details are tabulated below.

The second result, unexpected, but more important, has been to show that the value of log b varies between wider limits than those found by Weilenmann. For, as a result of recalculation, in the case of Geneva, the value of log b should be 1.965 instead of $\bar{1}.939$. In the case of Berne, recalculation confirmed Weilenmann's result of 1.935. This recalculation has been verified by the kindness of Dr. F. Maurer, of Zurich. Geneva was selected because, as may be seen from Table 1, the observations extended over a greater number of years than was the case with any other place. Berne was chosen because Weilenmann published a detailed and very convincing table giving the differences between the results as calculated and observed. Between two places so close to one another as Berne and Geneva, there is a variation in the value of

TABLE 2.—*Monthly means of temperature differences measured from midnight for Geneva (1836-1860), taken from Schweizerische Meteorologische Beobachtungen, 1872, p. xxxiv.*

Month.	5 p. m.	6 p. m.	7 p. m.	8 p. m.	9 p. m.	10 p. m.	11 p. m.	12 mid't.	1 a. m.	2 a. m.	3 a. m.	4 a. m.	5 a. m.	6 a. m.	7 a. m.
December	1.44	1.10	0.84	0.65	0.48	0.31	0.14	0	−0.08	−0.12	−0.14	−0.20	−0.30	−0.40	−0.42
January	1.70	1.30	0.99	0.74	0.55	0.37	0.18	0	−0.13	−0.20	−0.28	−0.40	−0.54	−0.68	−0.71
February	....	2.18	1.67	1.20	0.77	0.43	0.17	0	−0.13	−0.28	−0.49	−0.77	−0.99	−1.12	....
March	....	**3.42**	2.74	2.08	1.50	0.98	0.50	0	−0.54	−1.11	−1.61	−1.93	−1.96	**−1.62**	....
April	....	....	**3.01**	2.28	1.65	1.12	0.59	0	−0.68	−1.36	−1.89	−2.09	**−1.85**	....	....
May	....	....	....	**2.40**	1.69	1.10	0.57	0	−0.63	−1.22	−1.64	**−1.70**	....	....	....
June	....	....	....	**3.42**	2.49	1.64	0.82	0	−0.78	−1.40	−1.68	**−1.50**	....	....	....
July	....	....	**4.54**	3.47	2.49	1.63	0.83	0	−0.86	−1.65	−2.16	−2.20	**−1.64**	....	....
August	....	....	**3.79**	2.75	1.92	1.28	0.69	0	−0.86	−1.77	−2.49	−2.72	**−2.32**	....	....
September	....	....	**3.06**	2.16	1.46	0.94	0.50	0	−0.64	−1.37	−2.01	−2.33	−2.16	....	....
October	....	**2.49**	**1.81**	1.24	0.82	0.52	0.27	0	−0.34	−0.72	−1.10	−1.34	**−1.36**	**−1.09**	....
November	**1.99**	1.58	1.25	0.98	0.72	0.47	0.22	0	−0.18	−0.31	−0.42	−0.52	−0.59	−0.60	**−0.45**
Means	....	....	....	1.95	1.38	0.90	0.46	0	−0.49	−0.96	−1.33	−1.48	....	....	....

The figures in bold face type are obviously influenced by the sun's heat.

TABLE 3.—*Errors in calculated temperatures, using Weilenmann's values for the constants in the formula, $t=C(b^z-1)$, Geneva (1836-1860), p. xxxiv, xxxv.*

Month.	5 p. m.	6 p. m.	7 p. m.	8 p. m.	9 p. m.	10 p.m.	11 p. m.	12 mid't	1 a. m.	2 a. m.	3 a. m.	4 a. m.	5 a. m.	6 a. m.	7 a. m.	C.	−log b.
December	−0.02	−0.01	−0.01	−0.06	−0.07	−0.07	−0.03	0	−0.01	−0.05	−0.10	−0.10	−0.14	0.02	0.00	0.59	0.076
January	0.00	0.05	0.06	0.04	0.00	−0.03	−0.02	0	−0.02	−0.07	−0.10	−0.08	−0.02	0.03	0.00	1.22	0.054
February	....	−0.02	0.03	0.08	0.13	0.13	0.11	0	−0.11	−0.17	−0.15	−0.05	0.01	0.01	....	2.30	0.048
March	....	**0.15**	−0.09	−0.10	−0.11	−0.11	−0.09	0	0.18	0.57	0.65	0.72	0.53	**0.00**	....	3.08	0.054
April	....	....	0.56	0.39	0.23	0.05	−0.04	0	0.19	0.44	0.59	0.45	**−0.09**	....	....	4.25	0.053
May	....	....	....	**0.04**	0.06	0.01	−0.04	0	0.14	0.28	0.29	**−0.02**	....	....	....	5.83	0.048
June	....	....	....	−0.98	−0.74	−0.53	−0.29	0	0.29	0.46	0.23	−0.22	....	....	....	2.67	0.089
July	....	....	**0.14**	0.05	0.00	−0.07	−0.10	0	0.20	0.41	0.40	−0.02	**−1.00**	....	....	6.02	0.050
August	....	....	**0.89**	0.77	0.57	0.28	0.04	0	0.20	0.53	0.73	0.50	**−0.32**	....	....	5.90	0.043
September	....	....	**0.72**	0.71	0.58	0.35	0.11	0	0.09	0.31	0.50	0.41	**−0.14**	....	....	2.24	0.074
October	....	**0.01**	0.12	0.19	0.18	0.10	0.01	0	0.09	0.25	0.44	0.52	0.39	**0.00**	....	1.94	0.060
November	**−0.01**	−0.10	−0.16	−0.21	−0.20	−0.15	−0.08	0	0.07	0.11	0.14	0.19	0.20	0.18	**0.00**	0.58	0.092
Arithmetic mean	....	....	....	0.30	0.24	0.16	0.06	0	0.13	0.30	0.36	0.27	....	....	....	....	0.061
Algebraic mean	....	....	....	0.07	0.05	0.00	−0.03	0	0.11	0.26	0.30	0.19	....	....	....	....	....

TABLE 4.—*Errors in temperatures recalculated with new constants for the formula $t=C(b^z-1)$, Geneva (1836–1860).*

Month.	5 p. m.	6 p. m.	7 p. m.	8 p. m.	9 p. m.	10 p. m.	11 p. m.	12 mid't	1 a. m.	2 a. m.	3 a. m.	4 a. m.	5 a. m.	6 a. m.	7 a. m.	C.	−log b.
December	−0.02	−0.01	−0.01	−0.06	−0.07	−0.07	−0.03	0	−0.01	−0.05	−0.10	−0.10	−0.14	0.02	0.00	0.59	0.076
January	0.00	0.05	0.06	0.04	0.00	−0.03	−0.02	0	−0.02	−0.07	−0.10	−0.08	−0.02	0.03	0.00	1.22	0.054
February	......	−0.02	0.03	0.08	0.13	0.13	0.11	0	−0.11	−0.17	−0.15	−0.05	0.01	0.01	......	2.30	0.048
March	......	−0.02	0.01	0.03	0.03	0.00	−0.02	0	0.09	0.25	0.36	0.32	0.00	−0.65	......	6.89	0.029
April	......	......	−0.10	0.01	0.05	0.00	−0.04	0	0.14	0.29	0.30	−0.01	−0.76	......	......	25.1	0.0095
May	......	......	......	−0.11	0.02	0.03	0.00	0	0.07	0.11	−0.02	−0.50	......	......	......	55.4	0.0044
June	......	......	......	0.14	0.00	−0.09	−0.10	0	0.15	0.21	0.00	−0.60	......	......	......	5.16	0.057
July	......	......	0.08	0.00	−0.04	−0.09	−0.10	0	0.21	0.42	0.42	0.00	−0.97	......	......	6.01	0.495
August	......	......	−0.34	0.00	0.14	0.09	0.00	0	0.18	0.41	0.45	0.00	−1.07	......	......	250.0	0.00144
September	......	......	−0.39	−0.01	0.17	0.16	0.05	0	0.07	0.23	0.28	0.01	−0.77	......	......	−29.6	−.0082
October	......	−0.67	−0.28	0.00	0.12	0.11	0.05	0	0.02	0.07	0.11	0.01	−0.32	−0.95	......	−16.6	−.0084
November	−0.08	0.04	−0.01	−0.06	−0.08	−0.08	−0.04	0	0.02	0.02	0.01	0.02	0.00	−0.06	−0.28	1.12	0.065
Arithmetic mean	......	......	......	0.03	0.07	0.07	0.05	0	0.09	0.19	0.19	0.06	......	......	......	......	0.035
Algebraic mean	......	......	......	0.00	0.04	0.01	−0.01	0	−0.07	0.14	0.13	0.015	......	......	......	......	......

TABLE 5—*Errors in temperatures calculated by the formula $t=-a_1z+a_2z^2$, Geneva (1836–1860).*

Month.	5 p. m.	6 p. m.	7 p. m.	8 p. m.	9 p. m.	10 p. m.	11 p. m.	12 mid't	1 a. m.	2 a. m.	3 a. m.	4 a. m.	5 a. m.	6 a. m.	7 a. m.	a_1.	a_2.
December	−0.07	0.01	0.04	0.01	−0.01	−0.02	0.00	0	−0.04	−0.09	−0.15	−0.14	−0.08	0.01	0.03	0.125	0.010
January	−0.10	0.01	0.06	0.06	0.03	0.00	−0.01	0	−0.03	−0.09	−0.13	−0.12	−0.06	0.01	0.00	0.157	0.009
February	......	−0.07	0.02	0.10	0.16	0.16	0.09	0	−0.12	−0.20	−0.19	−0.08	0.00	0.02	......	0.268	0.014
March	......	−0.04	0.00	0.05	0.05	0.02	−0.01	0	0.09	0.28	0.34	0.30	0.00	−0.64	......	0.470	0.0156
April	......	......	−0.28	0.00	0.04	0.00	−0.04	0	0.14	0.29	0.31	00.0	−0.73	......	......	0.546	0.006
May	......	......	......	−0.13	0.00	0.02	−0.01	0	0.10	0.12	0.00	−0.47	......	......	......	0.555	0.003
June	......	......	......	0.08	0.00	−0.07	−0.08	0	0.13	0.19	0.00	−0.56	......	......	......	0.695	0.045
July	......	......	0.01	0.01	0.00	−0.05	−0.08	0	0.19	0.39	0.39	0.00	−0.91	......	......	0.721	0.043
August	......	......	−0.34	0.00	0.14	0.09	0.00	0	0.18	0.41	0.45	0.00	−1.07	......	......	0.684	0.001
September	......	......	−0.38	0.00	0.18	0.16	0.06	0	0.07	0.23	0.28	0.01	−0.77	......	......	0.561	−0.005
October	......	−0.45	−0.27	0.00	0.12	0.11	0.05	0	0.01	0.06	0.10	0.00	−0.33	−0.74	......	0.323	−0.003
November	−0.06	−0.01	0.00	−0.04	−0.05	−0.05	−0.02	0	0.01	−0.01	−0.01	−0.01	00.0	−0.04	−0.20	0.184	0.013
Arithmetic mean	......	......	......	0.03	0.065	0.06	0.04	0	0.09	0.19	0.20	0.055	......	......	......	......	......
Algebraic mean	......	......	......	0.02	0.055	0.03	−0.00	0	0.06	0.13	0.12	−0.00	......	......	......	......	......

TABLE 6.—*Geneva (1836–1860).*

Mean values taken from previous tables.

Table.	8 p. m.	9 p. m.	10 p. m	11 p. m.	12 mid.	1 a. m.	2 a. m.	3 a. m.	4 a. m.	−log b.
Table 2	1.95	1.38	0.90	0.46	0	−0.49	−0.96	−1.33	−1.48	......
Table 3	0.07	0.05	0.00	−0.03	0	0.11	0.26	0.30	0.19	0.061
Table 4	0.00	0.04	0.01	−0.01	0	−0.07	0.14	0.13	0.015	0.035
Table 5	0.02	0.055	0.03	−0.00	0	0.06	0.13	0.12	−0.00	......
The means of the errors, irrespective of sign.										
Table 3	0.30	0.24	0.16	0.08	0	0.13	0.30	0.36	0.27	0.061
Table 4	0.03	0.07	0.07	0.05	0	0.09	0.19	0.19	0.06	0.035
Table 5	0.03	0.065	0.06	0.04	0	0.09	0.19	0.20	0.055	......

log b from -0.065 to -0.035, a variation of 60 per cent of the mean value.

The final conclusion which I wish to draw is that, on theoretical grounds, the exponential is an inconvenient means of expressing the rate of nocturnal cooling. It would seem to be a wiser plan to take the nocturnal temperatures along with the diurnal temperatures, and study both together in the usual manner, by calculating the first few terms in the Fourier series which can be found to represent them.

The details of these calculations may be found in Tables 2–6. The latter sums up the results of the previous tables.

EARLY METEOROLOGICAL DATA FOR SALINE, MICH.[1]

By J. E. BUCHANAN. Dated Cambridge, Mass., May 12, 1908.

There is a certain interest in considering for the first time any old weather records from any portion of the United States, providing they be reliable. This interest is greatly increast if the records come from a locality for which no earlier observations exist.

Last December Prof. Cleveland Abbe received a letter from Mr. George R. Marvin, of Boston, Mass., concerning some old weather records for Saline, Mich., and referred this letter to Prof. R. DeC. Ward, of the Department of Geology and Geography of Harvard University. These observations are the subject of this paper.

The records to which Mr. Marvin referred were kept in the form of a diary by his great-grandfather, Mr. Thomas Pope. In order to understand why Mr. Pope kept such a careful diary, some salient points of his life need to be noted. He was born at New Bedford, Mass., and spent his early life in the New England States. He was graduated from Harvard in 1833, and no doubt acquired a scientific turn of mind while in college. In 1838 he moved to Saline, Mich., near which place he bought a farm, and began farming in a very scientific way for those days. Indications of his scientific methods in farming are seen from his diary, in which he recorded not only weather conditions but all details of farm life. The record of the early years is lost, but we have that portion of the diary which covers the period from September, 1847, to September, 1854.

The record consists mainly of temperature data. Mr. Pope took the temperature three times daily, and there is no record missing in the seven years. He also recorded the first frost, the date when the frost was out of the ground in the spring, the time of planting and harvesting of different crops, and other farm data, only parts of which are tabulated in this article.

Such records are of little value unless taken under proper conditions. To ascertain these conditions, Mr. Pope's daughter, Mrs. E. S. Ritchie, of Cambridge, Mass.; his daughter-in-law, Mrs. W. E. Pope, of Saline, Mich., and his son, Dr. F. H. Pope, of Bothwell, Canada, were consulted personally, or by letter. They agreed as to the manner of taking the temperature, the location of the thermometer, and the other conditions necessary to prove the reliability of the records.

Mr. Pope made readings three times daily, at 6 a. m., 12 m., 6 p. m., local time, not deviating from this time either summer or winter. If Mr. Pope was absent at any time, some one was

[1] A partial report made in the course in advanced climatology given under the direction of Prof. R. DeC. Ward, of Harvard University, 1907–8.

especially instructed to take the temperature. During the whole period the same clock and thermometer were used. The instrument was an ordinary mercurial Fahrenheit thermometer, maker not known. Mr. Pope, as can be determined from the records, also considered it very important to take exact readings, as many of his farm activities were guided by them from year to year. From this we can see that keeping this diary was not a secondary matter with him.

The thermometer was hung against the side of a wooden building under a latticed porch, on the north side of the building, about 6 feet from the ground.

The record for each month consists of four columns, one for the days of the month, and one for each of the three periods in the day when the temperature was taken. One, two, or three months were kept on the same page. Mr. Pope found the mean monthly temperature by adding all the temperatures recorded for the month and dividing by three times the number of days in the month. From these monthly means he found the seasonal and annual means. In the arithmetical work of Mr. Pope no mistake was found.

In the original records no corrections were made for the temperature observations, and as observations made at 6 a. m., 12 m., and 6 p. m. give a mean which is somewhat too high, the matter of corrections was investigated. I found three sets of (negative) corrections which could be used, as follows:

Corrections.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Average.	Authority.
I	.4	.4	.4	1.2	1.2	1.3	1.0	.9	.8	.5	.4	.3	.7	"Mean temperatures and their corrections." A. G. McAdie.
II	.6	.6	.7	1.1	1.6	1.8	1.8	1.5	1.1	.8	.5	.4	1.5	Prof. A. J. Henry.
III	.5	.6	.7	.9	1.0	1.2	1.3	1.2	1.1	1.0	.6	.5	.9	Smithsonian Contributions to Knowledge, No. 277.

Corrections No. I were calculated from tables given in "Mean temperatures and their corrections," publisht in 1891 by Prof. Alexander G. McAdie, and were based upon twelve years' observations, from 1877 to 1888, at Detroit.

Corrections No. II were very kindly furnisht me by Prof. A. J. Henry, from Weather Bureau records, and were based on hourly readings of the thermograph for ten years at Detroit.

Corrections No. III were given in Mr. Schott's temperature tables in the "Smithsonian Contributions to Knowledge," No. 277, and were based on observations at Toronto, Mohawk, New Haven, and Philadelphia for a period of years, not specified. The corrections sent by Professor Henry were used in this paper, as they represent the average of all, and were based on more accurate data.

Table 1.—*Monthly and annual means for Saline, Mich.*

Latitude 42° 10′ N., longitude 83° 47′ W.; altitude 816 feet.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
	°	°	°	°	°	°	°	°	°	°	°	°	°
1847...	......	......	......	......	......	......	......	......	58.5	46.6	40.0	29.3	......
1848...	**31.2**	30.7	33.9	**46.0**	**59.6**	65.9	**65.6**	67.5	**54.4**	48.4	**45.8**	29.4	**48.2**
1849...	24.8	23.4	37.5	42.3	54.2	66.8	67.6	66.5	59.8	47.9	**45.8**	26.2	46.9
1850...	30.8	29.3	**32.6**	42.8	**52.0**	67.8	72.7	68.7	58.5	48.2	43.1	25.8	47.7
1851...	29.2	**32.5**	40.2	43.7	56.7	**62.9**	67.7	**66.2**	62.5	48.3	35.6	**25.1**	47.5
1852...	22.2	**21.1**	**41.7**	**39.9**	56.5	64.8	70.8	66.8	58.7	**53.6**	**34.3**	**20.7**	**45.8**
1853...	26.7	25.1	33.8	44.1	53.0	**69.2**	67.5	68.1	61.1	**46.1**	40.0	26.6	46.7
1854...	**20.5**	25.3	34.7	45.6	56.6	66.2	**73.2**	**71.2**	**64.3**	......	......	......	......
Means	26.5	26.8	34.9	43.5	55.5	66.1	69.3	68.0	59.7	48.4	40.8	27.4	47.2

Extremes in bold-faced type.

Table 1 gives the monthly and annual mean temperatures based on the diary kept by Mr. Pope. The figures in bold-faced type represent the highest and lowest temperatures in each column for the given number of years.

Table 2.—*Monthly mean temperature for Ann Arbor, Mich.*

Latitude 42° 16′ N., longitude 83° 34′ W., altitude 850 feet.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
	°	°	°	°	°	°	°	°	°			
1854	21.4	25.9	35.6	47.0	58.7	68.5	75.1	73.9	66.0	......	......	......

Table 3.—*Monthly and annual means for Detroit, Mich.*

Latitude 42° 20′ N., longitude 83° 3′ W., altitude 597 feet.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
	°	°	°	°	°	°	°	°	°	°	°	°	°
1847...	......	......	......	......	......	......	......	......	59.4	33.9	36.8	24.2	......
1848...	26.2	28.6	30.8	47.8	58.0	67.2	65.7	70.1	55.9	45.8	30.1	25.7	46.0
1849...	21.5	23.3	36.0	44.9	56.7	71.2	73.8	70.3	63.4	49.0	47.1	27.4	48.7
1850...	31.2	29.8	34.7	43.6	55.6	71.4	76.0	72.2	61.8	49.8	44.3	25.9	49.7
1851...	30.6	33.2	40.3	46.2	57.9	65.9	70.7	67.8	65.2	50.1	36.4	25.9	49.2
1852...	22.6	28.0	33.2	41.8	58.4	70.1	74.3	72.7	60.5	57.1	37.9	32.2	49.2
1853...	29.8	29.8	37.4	53.9	59.8	70.0	74.9	75.1	67.1	49.7	43.0	30.1	51.7
1854...	23.8	26.6	36.6	45.0	58.7	69.3	74.9	73.0	65.8	......	......	......	......
Means.	26.5	28.5	35.6	46.2	57.9	69.3	72.9	71.6	62.4	47.9	39.5	27.5	48.1

Tables 2 and 3 represent the only observations for these same months in that section of Michigan. Table 2 covers but nine months of this period, and the observations were taken $3\frac{1}{2}$ miles east-southeast of Ann Arbor, which is 10 miles northeast of Saline. The observations were made at 7 a. m., 2 and 9 p. m. Comparing these observations with corresponding observations in Table 1, the remarkable similarity of the mean temperatures of these two places, Saline and Ann Arbor, is apparent.

Table 3 gives data for Detroit, for the entire period represented in Table 1 for Saline. There is not the same agreement in the mean temperatures of Detroit and Saline as is noticeable in the case of Ann Arbor and Saline. This is in part due to the differences in location. In Table 4 an attempt is made to show that the mean temperatures of Detroit compared with two stations (Lansing and Adrian) having more nearly the same conditions as Saline, range a degree or so higher. The records of these two stations were taken from Professor Henry's Climatology of the United States.

Table 4.—*Comparison of means for Detroit and Lansing, for the same period, also for Detroit and Adrian, Mich.*

Stations.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
	°	°	°	°	°	°	°	°	°	°	°	°	°
Detroit, Mich. 1887–1903	24.2	24.2	33.1	46.9	58.0	67.8	72.5	70.9	63.4	51.5	33.0	29.2	48.5
Lansing, Mich. 1887–1903	23.0	22.0	32.0	46.0	57.0	67.0	71.0	68.0	61.0	50.0	37.0	28.0	47.0
Detroit, Mich. 1878–1903	24.4	25.9	33.9	48.0	58.2	67.2	72.3	69.8	63.7	53.0	39.4	29.3	48.5
Adrian, Mich. 1878–1903	24.0	23.0	33.0	47.0	58.0	68.0	72.0	69.0	63.0	54.0	37.0	27.0	47.9

The records for Detroit were taken from a table in the report for March, 1907, of the Michigan section of the climatological service of the Weather Bureau. The longest record for Lansing is from 1887 to 1903, inclusive, and the data for Detroit were reduced to the same period. In the case of Adrian the period extended from 1878 to 1903, and the means for Detroit were also reduced to the same period. A comparison of these means for Detroit, Lansing, and Adrian shows a higher temperature for Detroit.

There is another reason for the disagreement of the contemporary data for Detroit and Saline. The observations that were made at Detroit were taken at various hours, so that it is impossible to reduce such data to the true means, as in the case of Saline.

TABLE 5.—*Monthly and annual mean temperatures at four stations for their longest periods.*

Stations.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
	°	°	°	°	°	°	°	°	°	°	°	°	°
Saline, Mich. 1847–1854	26.5	26.5	34.9	43.5	55.5	66.1	69.3	67.9	59.7	48.4	40.8	27.4	47.0
Detroit, Mich. 1873–1905	24.3	25.0	32.9	45.5	57.9	67.8	72.0	69.9	63.1	51.7	38.6	29.5	48.2
Lansing, Mich. 1887–1903	23.0	22.0	32.0	46.0	57.0	67.0	71.0	68.0	61.0	50.0	37.0	28.0	47.0
Adrian, Mich. 1878–1903	24.0	23.0	33.0	47.0	58.0	68.0	72.0	69.0	63.0	54.0	37.0	27.0	47.9

Table 5 shows the means for the longest periods of all stations where data were available. It was impossible to get any records for comparisons from either Ypsilanti or Ann Arbor, except such as have been noted.

TABLE 6.—*Mean temperatures of warmest and coldest days for each year for Saline, Mich.*

Coldest days.			Warmest days.		
Year.	Date.	Mean temperature.	Year.	Date.	Mean temperature.
		°			°
1847–48	December 26.	9	1848	June 17	80
1848–49	January 11.	2	1849	July 10.	80.6
1849–50	December 25.	7	1850	July 27.	82
1850–51	January 30.	5	1851	July 16.	78.6
1851–52	January 19.	5	1852	July 8.	80.3
1852–53	January 26.	2	1853	June 22	82
1853–54	January 21.	1.3	1854	August 1	83.6

In Table 6 are given the temperatures of the warmest and coldest days of each of the years. I have also underscored the temperatures of the warmest and coldest days in the period of the seven years. These are not the extremes of the temperatures, but are the true daily means.

TABLE 7.—*Date of first frost and the mean date for the seven-year period at Saline, Mich.*

Year.	Date.	Conditions.
1847	September 14.	Very heavy.
1848	September 13.	
1849	September 8.	Slight.
1851	September 28.	
1852	September 16.	
1853	August 28.	
1854	September 16.	
Average	September 13.	

TABLE 8.—*Date for each year when frost was out of ground or the ground was free from frost from 1848 to 1854 at Saline, Mich.*

Year.	Date.	Conditions.
1848	March 24	
1849	March 14	Nearly.
1850	March 13	Except under fences.
1851	February 26	
1852	March 14	
1853	March 21	
1854	March 15	
Average	March 14	

TABLE 9.—*Comparison of early frost for four stations for years covered by Table 5.*

Station.	Average date of first killing frost in autumn.	Date of earliest frost recorded.
Lansing, Mich.	September 15.	
Detroit, Mich.	October 9	September 17.
Adrian, Mich.	October 11	September 20.
Saline, Mich.	September 13.	August 28.

In Tables 7 and 8 are shown the dates in the different years of the first frost and when the frost was out of the ground, and in Table 9 a comparison has been made of the average time of the first killing frost and the date of the earliest recorded frost for the four stations, Lansing, Detroit, Adrian, and Saline. The record as kept by Mr. Pope does not indicate generally the severity of the frost. This undoubtedly accounts for the average in the case of Saline. All the comment that he made concerning the nature of the frost is indicated under "conditions" in the tables.

TABLE 10.—*Various farm activities from 1847 to 1855 for Saline, Mich.*

Year.	Winter wheat.		Clover.	Maize.	Apple trees.
	Sown.	*Harvested.*	*Sown.*	*Planted.*	*Bloomed.*
1847	September 1.				
1848	September 22.	July 18.	March 25.	May 10.	May 5.
1849	September 17.	July 14.	March 17.	May 18.	May 17.
1850	September 11.	July 12.	March 22.	May 16.	May 18.
1851	September 3.	July 2.	March 14.	May 13.	May 10.
1852	September 14.	July 12.		May 13.	May 21.
1853	September 2.	July 8.		May 13.	May 17.
1854		July 17.		May 15.	May 12.
1855				May 17.	May 11.
Average	September 10.	July 12.		May 14.	May 14.

Table 10 indicates the dates of various farm activities for the different years. There is a rather remarkable uniformity in the dates of planting corn and the blossoming of the apple trees. Also, as we would expect from an observing scientific farmer, if the wheat were sown early it was harvested early and not allowed to overripen.

In this connection it may be worth noting that Mr. Pope very carefully followed what he found to be the best scheme for wheat yield, namely, letting the ground remain idle for a year and fallowing it in the summer. In this as well as in crop rotation he was doubtless a pioneer.

I desire to acknowledge the assistance rendered me by Prof. A. J. Henry, by his advice and by the data furnished me; by Mr. C. F. Schneider, Section Director of Michigan State Weather Service, for reports which he sent me. I am also greatly indebted to Mrs. E. S. Ritchie and to other relatives of Mr. Pope, who have made possible this report.

EXCESSIVE PRECIPITATION AT LOUISVILLE, KY.

By F. J. WALZ, B. S., District Forecaster. Dated Louisville, Ky., May 14, 1908.

Many requests have been made for information bearing on the frequency of excessive precipitation at Louisville. In order to meet the demand for these data, the records have been carefully examined, beginning with 1871, and after careful verification, the entire record of excessive amounts during the past thirty-six years, from January, 1872, to May, 1908, has been tabulated, and appears in Table 1.

Precipitation is considered excessive, (1) when 2.5 inches fall in twenty-four hours, or (2) when the rate of precipitation for any short period is equal to, or exceeds, an inch per hour, provided that the total rainfall amounts to at least five-tenths of an inch. During the thirty-six years considered, there have been 80 instances of rainfall belonging to one or the other of these cases. (See Table 2.) They occurred for the most part during the summer months, as shown by count of cases by months, viz, January 3, February 3, March 3, April 5, May 11, June 12, July 13, August 11, September 3, October 4, November 7, and December 5.

The heaviest rainfall in one day was on July 4, 1896, when 5.50 inches were recorded between 4.52 and 8.30 p. m., and 2.70 inches between 5 and 6 p. m., of which 1.05 inches occurred in an interval of ten minutes. Streets were flooded to a depth of 2 to 4 feet, and the sewers could not carry off the water. Later in the same month, 20th–21st, there was a rainfall of 4.19 inches, being the total of several very heavy showers scattered thru the night and day. Again there was much damage thruout the city. Even heavier rains than this at Louisville fell on this latter date at several places in the interior of the State. At Shelbyville, 30 miles east of Louisville, 7.15 inches fell in twenty-four hours, doing an immense amount of damage.

The greatest precipitation in any one month was 16.46 inches, in July, 1875. Other large monthly amounts were 13.01 inches, July, 1896; 12.11, January, 1907; 11.43, January 1876; 10.53, August, 1888; and 10.02, August, 1879.

There is nothing to indicate any material change in the frequency of excessive rainfalls from one period to another. Thus, out of 80 cases, 24 occurred in the period 1872–1880, 14 in 1881–1890, 18 in 1891–1900, and 24 in 1900–1907. The slight apparent increase in the number in recent years is in some measure due to the introduction of recording gages; the float type of gage was introduced October 1, 1894, and the tipping-bucket type January 1, 1898.

A count of the cases in the individual years indicates a fair distribution, except that the last three years, 1905–1907, include 19 cases. This appears to be due to better methods of measurement during especially heavy periods of rainfall, and not to recurring cycles of excessive rainfall.

TABLE 1.—*Excessive rainfalls at Louisville, Ky., from January, 1872, to May 12, 1908.*

Month and year.	2.50 inches or more in 24 hours.		Excessive amounts for short periods.			Month and year.	2.50 inches or more in 24 hours.		Excessive amounts for short periods.		
	Amount.	Date.	Amount.	Time.	Date.		Amount.	Date.	Amount.	Time.	Date.
				Hr.m.						*Hr.m.*	
Jan., 1876...	3.48	18	......	......	......	July, 1877..	2.64	18	......	......	......
Jan., 1898...	2.55	22	......	......	......	July, 1892..	......	......	2.00	1:50	3
Jan., 1907...	3.23	2	......	......	......	July, 1894..	......	......	1.00	1:00	19
Feb., 1880...	2.51	13	......	......	......	July, 1896..	5.50	4	2.70	1:00	4
Feb., 1882...	2.97	20	......	......	......	July, 1896..	4.19	20–21	1.29	1:00	21
Feb., 1883...	2.68	6–7	......	......	......	July, 1897..	......	......	1.39	1:00	10
Feb , 1908...	2.70	4–5	......	......	......	July, 1901..	......	......	1.13	0:30	3
Mar., 1890...	2.51	10–11	......	......	......	July, 1906..	......	......	0.59	0:30	27–28
Mar., 1897...	......	......	0.50	0:15	23	July, 1907..	......	......	0.63	0:20	9
Mar., 1898...	......	......	1.19	1:00	16–17	July, 1907.	......	......	0.79	0:30	15
Mar., 1908...	......	......	0.62	0:25	31	July, 1907..	......	......	0.55	0:15	18
Apr., 1872...	3.56	8	......	......	......	Aug., 1878..	......	......	0.63	0:15	19
Apr., 1880...	4.06	15–16	......	......	......	Aug., 1879..	2.97	15–16	......	......	......
Apr., 1883...	3.64	5–6	......	......	......	Aug., 1879..	3.78	24–25	......	......	...
Apr., 1887...	3.28	22–23	......	......	......	Aug., 1882..	3.27	24	......	......	......
Apr., 1892...	2.50	20–21	......	......	......	Aug., 1884..	2.87	28–29	......	......	......
May, 1872...	......	......	0.99	0:40	25	Aug., 1888..	2.87	20–21	0.54	0:30	1
May, 1873...	......	......	1.34	0:50	1	Aug., 1891..	2.82	2	2.50	2:00	2
May, 1878..	......	......	1.30	1:05	27	Aug., 1898..	3.68	8–9	2.66	1:23	8
May, 1880...	3.89	29–30	......	......	......	Aug., 1905..	......	......	0.60	0:15	7
May, 1889...	2.99	29–30	......	......	......	Aug., 1905..	......	......	1.00	0:46	23
May, 1902...	3.53	22–23	1.08	1:00	23	Aug., 1907..	......	......	0.54	0:20	20
May, 1903...	2.97	31–1	1.05	0:15	31	Sept., 1879..	2.99	2–3	......	......	......
May, 1905...	2.64	13–14	......	......	......	Sept., 1896..	2.74	27–28	......	......	......
May, 1906...	......	......	0.83	0:18	31	Sept., 1905..	......	......	0.65	0:20	1
May, 1906...	......	......	0.66	0:25	4	Oct., 1876..	4.12	29	......	......	......
May, 1906...	......	......	0.85	0:20	31	Oct., 1880..	3.23	15	......	......	......
May, 1908...	......	......	0.67	0:20	6	Oct., 1883.	3.31	28–29	......	......	......
June, 1872...	3.02	3	......	......	......	Oct., 1893..	2.63	2–3	......	......	......
June, 1878...	2.92	17	0.95	0:37	27	Nov., 1878..	2.81	26–27	......	......	......
June, 1881...	......	......	0.78	0:27	16	Nov., 1883..	2.91	21–22	......	......	......
June, 1890...	......	......	1.22	1:00	15	Nov., 1900.	3.16	20–21	......	......	......
June, 1890...	......	......	0.84	0:30	19	Nov., 1900..	2.50	24–25	......	......	......
June, 1895...	2.66	19–20	0.51	0:05	4	Nov., 1905..	2.81	28–29	1.00	0:46	28
June, 1896...	2.87	22–23	1.00	0:10	23	Nov., 1906..	2.85	17–18	......	......	......
June, 1896...	......	......	1.37	0:46	23	Nov., 1906..	3.15	19–20	......	......	......
June, 1901..	......	......	1.25	1:00	20	Dec., 1873..	3.87	3	......	......	......
June, 1902...	......	......	1.12	0:53	15	Dec., 1875..	2.99	23–24	......	......	......
June, 1905...	......	......	0.48	0:15	7	Dec., 1879..	3.07	23–24	......	......	......
June, 1905...	......	......	1.00	1:00	19	Dec., 1880..	2.83	4	......	......	......
July, 1875...	2.97	11–12	......	......	......	Dec., 1905..	2.86	1–2	......	......	......
July, 1875...	3.68	29	......	......	......						

TABLE 2.

NUMBER OF EXCESSIVE PERIODS OF RAINFALL.

1872.......3	1881.......1	1890.......3	1899.......0
1873.......3	1882.......2	1891.......1	1900.......2
1874.......0	1883.......4	1892.......2	1901.......2
1875.......3	1884.......1	1893.......1	1902.......2
1876.......2	1885.......0	1894.......1	1903.......1
1877.......1	1886.......0	1895.......1	1904.......0
1878.......3	1887.......1	1896.......5	1905.......8
1879.......4	1888.......1	1897.......2	1906.......6
1880.......5	1889.......1	1898.......3	1907.......5

RECAPITULATION BY MONTHS.

January....... 3	May..........11	September..... 3
February...... 3	June.........12	October........ 4
March.......... 3	July..........13	November...... 7
April.......... 5	August.......11	December..... 5

RECAPITULATION BY PERIODS.

1872–1880, inclusive.....24	1891–1900, inclusive.....18
1881–1890, inclusive.....14	1901–1907, inclusive.....24

A NEW FORMULA FOR COMPUTING THE SOLAR CONSTANT FROM PYRHELIOMETRIC OBSERVATIONS.

By H. H. KIMBALL.

[Read before the U. S. Weather Bureau Committee, April 29, 1908.]

An attempt has been made to develop an empirical formula by means of which the solar constant may be computed from pyrheliometric observations with an accuracy comparable with the accuracy of the observations themselves.

As suggested by Ångström,[1] if we express the coefficient of general atmospheric transmission for any wave length by the equation

$$y_\lambda = \varphi(\lambda) \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

and the corresponding intensity of solar radiation by

$$I_\lambda = \Psi(\lambda) \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

then the radiation received at the surface of the earth after the solar rays have past thru an atmospheric diffusing layer of thickness m will be exprest by

$$Q_m = \int_{\lambda_1}^{\lambda_2} \Psi(\lambda)\,[\varphi(\lambda)]^m\, d\lambda \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

Since the function $\Psi(\lambda)$ is not exprest by any known law, the problem may be simplified by assuming a dispersion, x, that will give a solar spectrum of constant intensity. Such a dispersion has been computed from Abbot's values of the intensity of the normal solar spectrum outside the atmosphere.[2]

Equation (3) now takes the form—

$$Q_m = \int_{x_1}^{x_2} [\varphi(x)]^m\, dx \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (4)$$

TABLE 1.—*Vertical transmission of atmosphere.*

λ	x	Above Washington.		Above Mount Wilson.	
		Observed.	Computed.	Observed.	Computed.
0.387	0.0133	0.430	0.433	0.6844	0.6599
0.390	0.0171	0.445	0.454	0.6897	0.6754
0.3942	0.0245	0.499	0.482	0.7090	0.6981
0.3987	0.0334	0.535	0.510	0.7180	0.7183
0.4037	0.0435	0.553	0.533	0.7301	0.7360
0.4091	0.0541	0.564	0.555	0.7411	0.7509
0.4147	0.0641	0.575	0.572	0.7504	0.7627
0.4210	0.0751	0.587	0.588	0.7654	0.7739
0.4275	0.0866	0.594	0.603	0.7728	0.7841
0.4343	0.0987	0.611	0.617	0.7852	0.7936
0.4417	0.1122	0.631	0.631	0.7917	0.8030
0.4494	0.1267	0.639	0.645	6.8054	0.8120
0.4578	0.1427	0.647	0.659	0.8165	0.8210
0.4666	0.1595	0.666	0.672	0.8274	0.8294
0.4762	0.1777	0.674	0.685	0.8308	0.8377
0.4861	0.1962	0.689	0.697	0.8378	0.8454
0.4974	0.2144	0.702	0.708	0.8469	0.8523
0.5094	0.3252	0.710	0.720	0.8591	0.8596
0.5226	0.2576	0.717	0.732	0.8645	0.8668
0.5370	0.2818	0.725	0.743	0.8683	0.8740
0.5525	0.3073	0.740	0.755	0.8751	0.8810
0.5697	0.3346	0.745	0.766	0.8742	0.8879
0.5889	0.3641	0.751	0.778	0.8785	0.8948
0.6098	0.3943	0.768	0.789	0.8890	0.9015
0.6333	0.4280	0.791	0.800	0.9068	0.9082
0.6610	0.4636	0.815	0.812	0.9235	0.9149
0.6925	0.5013	0.835	0.823	0.9340	0.9216
0.7280	0.5408	0.850	0.834	0.9449	0.9280
0.7690	0.5819	0.860	0.845	0.9522	0.9343
0.818	0.6250	0.871	0.856	0.9588	0.9404
0.877	0.6707	0.883	0.867	0.9631	0.9466
0.946	0.7148	0.892	0.876	0.9675	0.9521
1.034	0.7610	0.906	0.886	0.9687	0.9576
1.127	0.8010	0.912	0.894	0.9706	0.9621
1.239	0.8407	0.915	0.902	0.9711	0.9664
1.367	0.8768	0.917	0.909	0.9746	0.9702
1.508	0.9082	0.923	0.914	0.9775	0.9733
1.648	0.9337	0.933	0.919	0.9756	0.9758
1.786	0.9545	0.926	0.922	0.9724	0.9778
1.924	0.9709	0.916	0.925	0.9800	0.9793
2.060	0.9817	0.904	0.927	0.9600	0.9803
2.196	0.9880	0.909	0.928	0.9740	0.9809
2.316	0.9919	0.894	0.929	0.9649	0.9812
2.428	0.9947	0.875	0.929	0.9251	0.9815

[1] Méthode nouvelle pour l'étude de la radiation solaire par Knut Ångström. Nova Acta Regiæ Societatis Scientiarum Upsaliensis. Ser. 4. Vol. 1, N. 7.

[2] Annals of the Astrophysical Observatory of the Smithsonian Institution. Vol. II, p. 105.

and equation (1) may be written

$$y_x = \varphi(x) \quad \ldots\ldots\ldots\ldots \quad (5)$$

In Table 1, "Vertical transmission of atmosphere," are given Abbot's values of atmospheric transmission above Mount Wilson and Washington,[3] and also the values of x computed for the different values of λ.

Assuming that $\varphi(x)$ has the exponential form, we may express (5) by

$$y_x = p x^n \quad \ldots\ldots\ldots\ldots \quad (6)$$

Substituting for y_x the mean atmospheric transmission factors for Washington given in column 3 of Table 1, and solving equation (6) by the least-squares method, we obtain

$$y_x = 0.93 x^{0.18} \quad \ldots\ldots\ldots\ldots \quad (7)$$

Similarly, substituting the mean atmospheric transmission above Mount Wilson given in column 5 of Table 1, we obtain

$$y_x = 0.98 x^{0.09} \quad \ldots\ldots\ldots\ldots \quad (8)$$

The difference in the constants of these two equations is without doubt due to the difference in the general atmospheric absorption, viz, the scattering by the gas molecules and dust particles, above the two observing points. The transmission is the complement of the absorption, and Ångström suggests that we consider the general transmission as depending on the density of the atmospheric diffusing layer. Representing this density by δ, we may introduce this term in equation (6) as follows:

$$y_x = p^{\delta} x^{n\varphi(\delta)} \quad \ldots\ldots\ldots\ldots \quad (9)$$

Assuming that for the mean conditions at Washington $\delta=1$, from equations (7) and (8), we find that for the mean conditions at Mount Wilson $\delta=0.25$, and $\varphi(\delta)=\delta^{\frac{1}{2}}$.

Equations (7) and (8) may therefore be exprest by the general equation

$$y = 0.93^{\delta} x^{0.18\delta^{\frac{1}{2}}} \quad \ldots\ldots\ldots\ldots \quad (10)$$

In columns 4 and 6 of Table 1 are given the computed transmission coefficients when $\delta=1$ and 0.25, respectively.

This equation therefore enables us to compute the general atmospheric transmission corresponding to any wave length and to densities of the diffusing atmospheric layer representing the mean conditions at Washington and at Mount Wilson. The equation is now to be tested to see if it is applicable to other values of δ.

For observations thru any air mass m equation (10) takes the form

$$y_x^m = 0.93^{m\delta} x^{0.18m\delta^{\frac{1}{2}}} \quad \ldots\ldots\ldots\ldots \quad (11)$$

Integrating this equation between the limits $x=0$ and $x=1$, and at the same time multiplying by the solar constant, since we have assumed the ordinate of our spectrum of constant intensity to be 1, we obtain

$$Q_m = Q_0 \int_{x_0}^{x_1} 0.93^{m\delta} \left(x^{0.18m\delta^{\frac{1}{2}}}\right) dx = Q_0 \frac{0.93^{m\delta}}{1+0.18\, m\delta^{\frac{1}{2}}}, \quad \ldots \quad (12)$$

where Q_m' = the total radiation that would be received at the surface of the earth after passing thru a diffusing atmospheric layer of thickness m and density δ, disregarding the losses due to such absorption by gases as is represented by the bands of the solar spectrum.

Abbot[4] states that the percentage of depletion of solar radiation due to absorption by water vapor above Mount Wilson may be exprest by the equation

$$F_w = 5.7 + 0.12\ E_w m \quad \ldots\ldots\ldots\ldots \quad (13)$$

and above Washington by

$$F_0 = 5.2 + 0.12\ E_0 m \quad \ldots\ldots\ldots\ldots \quad (14)$$

He also states that the difference between the first terms of the second members of these two equations is probably due to the fact that "Owing to the general absorption being greater above Washington than above Mount Wilson there is less radiation available to be absorbed by water vapor above Washington."

In other words,

$$F_0 = \varphi(\delta) + 0.12\ E_0 m \ldots\ldots\ldots\ldots (15)$$

where $E_0 = 2.3\ e_0$ represents the depth in millimeters to which the earth's surface would be covered by water if all the aqueous vapor were precipitated, e_0 representing the vapor pressure at sea level in millimeters.

Equation (15) takes the form

$$F_0 = (5.9 - 0.8\delta) + 0.12\ E_0 m \ldots\ldots\ldots\ldots (16)$$

Equation (16) does not allow for the slight band absorption by atmospheric gases other than water vapor. From an examination of bolograms made at the Astrophysical Observatory, Washington, this apparently amounts to only about 0.2 per cent of the solar radiation.

The total band absorption may, therefore, be exprest by

$$F_0' = (6.1 - 0.8\ \delta) + 0.12\ E_0 m \ldots\ldots\ldots\ldots (17)$$

Subtracting equation (17) from equation (12) we obtain

$$Q_m = Q_0 \frac{0.93^{m\delta}}{1 + 0.18 m\delta^{\frac{1}{2}}} - \left[(6.1 - 0.8\delta) + 0.12\ E_0 m.\right] \ldots (18)$$

Equation (18) represents the total radiation received at the surface of the earth after the rays have been depleted both by general atmospheric absorption or scattering and also by selective gas absorption. From observations thru two air masses, as thru m and $m+1$, we obtain

$$\frac{Q_{m+1}}{Q_m} = \frac{\dfrac{0.93^{\delta(m+1)}}{1+0.18(m+1)\delta^{\frac{1}{2}}} - \left[(6.1-0.8\delta)+0.12\ E_0(m+1)\right]}{\dfrac{0.93^{\delta m}}{1+0.18m\delta^{\frac{1}{2}}} - \left[(6.1-0.8\delta)+0.12\ E_0 m\right]} . (19)$$

from which δ may be computed. Having determined δ, the solar constant is found at once from equation (18) in the form

$$Q_0 = \frac{Q_m}{\dfrac{0.93^{\delta m}}{1+0.18m\delta^{\frac{1}{2}}} - \left[(6.1-0.8\delta)+0.12\ E_0 m\right]} \ldots (20)$$

Tables have been constructed giving the value of $\frac{Q_{m-1}}{Q_m}$ when $m=2$ for values of δ ranging from 0.20 to 2.20, and for values of e_0 ranging from 0.25 to 20 millimeters; and also giving the values of the denominator of the second member of equation (20) for the same limits of δ and e_0.

By means of these tables the value of the solar constant has been computed from observations made with the Ångström pyrheliometer at the Weather Bureau in Washington on 57 different occasions between December 22, 1905, and February 8, 1908, generally on different days, but occasionally in the morning and in the afternoon of the same day. The mean of these values is 2.004, or within 1 per cent of the value computed by Abbot from bolometric observations made at Mount Wilson.[5]

The highest value obtained was 2.247, on January 9, 1906, and the lowest value was 1.837, on November 15, 1907. On neither of these days were the meteorological conditions considered good. On only five occasions did the computed values of the solar constant fall below 1.90, and on only two occasions did they exceed 2.15. Under favorable conditions variations greater than 5 per cent from the mean have not been found.

[3] Ibid., p. 111 and 113.

[4] Ibid. p. 130.

[5] Ibid, pp. 96 and 97.

All pyrheliometric readings have been reduced to the Smithsonian Institution actinometric scale by means of the factors given in Table 6, Summary of Comparison of Pyrheliometers, Bulletin of the Mount Weather Observatory, Vol. I, part 2, p. 92.

TABLE 2.—*Comparison of computed values of the solar constant.*

Date.	Bolometric determinations.		Pyrheliometric determinations.
	Mount Wilson.	Astrophysical Observatory.	Weather Bureau.
1906.	*Solar constant.*	*Solar constant.*	*Solar constant.*
January 9		2.252	2.249
February 15		2.215	2.075
May 29	2.008	2.154	2.000
October 13	1.984		
October 15			2.006
October 16	2.043		
November 6		2.098	2.113
November 22		2.046	1.942
1907.			
February 15		1.972	2.006
May 13		2.119	2.035
Means		2.122	2.053

Table 2 gives comparisons between computations made by equation (20) from pyrheliometric observations obtained at the Weather Bureau in Washington, and bolometric determinations made by the Smithsonian Institution at the Astrophysical Observatory in Washington, and on Mount Wilson.[6]

These ten days are the only ones on which simultaneous observations were obtained, due to the fact that atmospheric conditions at Washington are unfavorable for pyrheliometric measurements during the summer months.

It will be noted that on May 29, and again in October, 1906, the agreement between the Weather Bureau pyrheliometric and the Mount Wilson bolometric determinations is very close. The agreement with the Washington bolometric determinations is not so good, but in most cases the cause is apparent and will be discust at another time.

A complete discussion of the pyrheliometric observations made by myself at Washington and by others at Mount Weather will appear in Bulletin of the Mount Weather Observatory, Vol. I, Part 4.

In my own observations the value of δ has ranged from 0.255 to 1.96, and the value of e_0 from 0.91 to 9.47. It therefore appears that the formula here developed enables us to compute the solar constant with a degree of accuracy comparable with that attainable with any apparatus at sea level, where the atmospheric conditions are too variable for highly accurate determinations.

The simplicity of the process should lead to its very general use in the reduction of pyrheliometric readings, and from the very many observations now being made in all parts of the world it should be easy to detect variations in the solar constant of 3 per cent or more if they occur.

The absolute value of the solar constant is dependent on the accuracy of the pyrheliometric scale employed. Unfortunately different types of pyrheliometers are not in accord; but by means of the data given in Table 6 of Vol. I, Part 2, Bulletin of the Mount Weather Observatory above referred to, it is believed that the relation between the Smithsonian actinometric scale and Ångström's pyrheliometric scale has been established. Comparisons between the Ångström and other types of instruments should now make it possible to establish the relations between all of the more important types of pyrheliometers in use, and thus make comparable the results obtained in all parts of the world. The need of an international pyrheliometric standard is, however, apparent.

[6] Ibid., 97-98.

NOTES FROM THE WEATHER BUREAU LIBRARY.

By C. FITZHUGH TALMAN, Assistant Librarian.

METEOROLOGY IN ROUMANIA.

Meteorologists will regret to learn that St. C. Hepites, who for so many years has been the official head of meteorology in Roumania, has severed his connection with the meteorological institute of that country, on account of a change in its affiliations recently decided upon by the Roumanian Government.

The Meteorological Institute of Roumania was founded by Hepites in 1884, and was attached to the Ministry of Agriculture, Industry, Commerce, and Domains. At that time, in addition to ten rainfall stations, there were but three places in Roumania at which meteorological observations were carried on. The number of stations is now over 400. In 1889 a metrological section was added to the institute. Seismology, also, has been cultivated in recent years. The results of observations have been published, in French and Roumanian, in a series of bulky yearbooks, besides other periodical and occasional publications in great number, and M. Hepites himself has been a most industrious writer upon the meteorology of his country.

Last year M. Hepites retired from the active directorship, in favor of M. I. St. Murat, and became honorary director, retaining charge of the purely scientific work. He has now left the institute altogether, on account of the transfer of the meteorological section to the astronomical observatory connected with the chair of astronomy at the University of Bukharest.

The section of weights and measures, of which M. Murat continues to be director, has been transferred to a newly organized Department of Industry and Commerce.

OBSERVATIONS BEGUN ON LAKE CONSTANCE.

Dr. E. Kleinschmidt, late assistant in the Meteorological Service of Alsace-Lorraine, at Strassburg, is in charge of the new kite station on Lake Constance, an account of which was published in the February MONTHLY WEATHER REVIEW, 1908, p. 21. This station began work April 1, and is now making observations every day, so far as conditions permit, with kites and captive balloons. The results are communicated daily to the Deutsche Seewarte, at Hamburg, and to the central meteorological stations of Bavaria, Württemberg, Baden, and Alsace-Lorraine, for utilization in connection with the daily weather forecasts.

CLIMATIC CHARTS OF CANADA.

The Weather Bureau has received a copy of the official Atlas of Canada, prepared by the government geographer, James White, and issued by the Canadian Department of the Interior. Although published in 1906, it appears to have escaped the attention of climatologists generally, until Petermanns Mitteilungen noticed it in the last annual summary of the literature of local climatology (54. Band, 1908, Heft 2).

Three plates of this atlas, viz, Nos. 25, 26, and 26A, are devoted to climate. The first gives isothermal charts for the twelve months of the year; the second comprises isotherms for the summer and for the year, precipitation and snowfall charts (annual) for southern Canada, and annual and quarterly isobars (the latter unfortunately referring to the quarters of the calendar year instead of the natural seasons); the third gives seasonal charts of the average possible hours of sunshine, and a series of charts showing the number of days in the year with mean temperature above 32°, 40°, 50°, 60°, and 70° F.

This is, we believe, the only extensive series of climatic charts yet issued for Canada.

THE SENSIBLE TEMPERATURE.

The much mooted question of the sensible temperature is discust by J. Vincent in a memoir entitled "Nouvelles recher-

ches sur la température climatologique," published by the Meteorological Service of Belgium (Brussels, 1907). The principal object of this memoir is to show that the rôle played by the humidity of the air in determining the superficial temperature of the body has been much overrated by nearly all previous writers on the subject. M. Vincent's measurements of the temperature of the skin were made by applying a thermometer to the back of his left hand, and he concludes, as the result of a long series of experiments, that when the temperature is below the degree necessary to produce visible perspiration (the most frequent case in temperate climates) the humidity of the air has no influence whatever upon the sensible temperature, or temperature felt by the body. The only factors to be considered are the temperature of the air and the velocity of the wind; the temperature of the skin is exprest by the equation

$$p = 30.1 + 0.2\,t - v(4.12 - 0.13\,t)$$

in which p is the temperature of the skin, t the temperature of the air, and v the velocity of the wind in meters per second. (The temperatures are centigrade.)

This formula does not apply to the case of exposure to direct sunshine, which introduces the additional factor of solar radiation, not as yet satisfactorily dealt with.

HIGH PRESSURE OVER EUROPE IN JANUARY, 1907.

The library has cataloged no less than eight papers, in the meteorological and physical journals, on the remarkably high barometric pressure that prevailed over eastern and central Europe during the third decade of January, 1907. The latest is by J. Vincent, in the "Annuaire météorologique" of the Royal Observatory of Belgium for 1908. M. Vincent gives a map of the isobars at 7 a. m., January 23, from which it appears that the pressure, reduced to sea level, then approximated 800 millimeters (nearly 31.50 inches) in the Baltic provinces of Russia. This is the "record" pressure for that region.

THE CLIMATE AND WEATHER OF BALTIMORE.

A German climatologist, Dr. Ernst Ludwig Voss, in a recent memoir on the rainfall of South America[1], pays a high tribute to the first volume of the special publications of the Maryland Weather Service, which, he says, "appeared excellently adapted, in many respects, to serve as a model for my own work," and which he names along with the classic works of Hugo Meyer and Hann.

If this encomium was deserved by Volume I it is even more so by Volume II[2], in which the methods of the earlier volume are expanded and developed, until the work becomes a mine of suggestions for the climatologist. Volume II deals with the climate and weather of Baltimore, and is by Dr. Oliver L. Fassig. This work contains so many admirable features—so much that is worthy of detailed study—that we can not hope to do it justice in a brief note, and will therefore only repeat the statement made by Director Clark, in the introduction, that it is "probably the most complete study that has ever been given to the climate and weather of a single city and its environs."

Climatologists will be glad to learn that the series of memoirs devoted to the several counties of Maryland, now in course of publication, will ultimately be collected to form yet another volume of the special publications of the Maryland Weather Service.

Why, by the way, are these special publications without a collective name? The title-pages read "Maryland Weather Service, Volume One," "Maryland Weather Service, Volume Two." But "Maryland Weather Service" is, technically, an author, not a title, and bibliographers who deal with these works are put to the necessity of interpolating a title in square brackets.

[1] See the Monthly Weather Review for December, 1907, p. 576.

[2] Maryland weather service. Volume II. Baltimore: Johns Hopkins press. 1907. (An edition is also issued in which the title page and cover read: The climate and weather of Baltimore. * * *) Parts Ia and Ib, devoted to the climate of Baltimore, were separately issued in 1904–5.

APPARATUS FOR PROTECTION FROM FROST AND HAIL.

The Scientific American Supplement of May 9, 1908, contains an illustrated account of apparatus recently brought out in France for protecting vines and fruit trees from injury by frost and hail. Screens of canvas and straw matting, attached to a system of framework, are so adjusted that the action of a single lever at a central station will spread them simultaneously over the entire region to be protected. Protection against frost is automatic; a thermometer is arranged to release a counterweight when the temperature falls to the danger point, and wires leading from the counterweight mechanism draw the screens.

The inventor, M. Becker-Bertrand, of Rheims, has successfully applied his invention in the champagne-producing districts of France.

THE RAINFALL OF ALSACE-LORRAINE.

This is the subject of a memoir by E. Kleinschmidt, publisht as an appendix to the "Deutsches Meteorologisches Jahrbuch" of Alsace-Lorraine for 1903 (Strassburg i. E., 1907). The tables include the mean monthly and yearly rainfall reduced to the 25-year period 1881–1905, and the mean rainfall for each lustrum from the beginning of observation, for some 60 stations; also the mean number of days with rain during the period 1891-1905, for 37 stations.

This memoir supplements the corresponding sections of Hellmann's great work "Die Niederschläge in den norddeutschen Stromgebieten" (Berlin, 1906), which, while including a greater number of stations for Alsace-Lorraine, brings their records only down to 1890.

BRITISH SECOND-ORDER STATIONS.

The British Meteorological Office has taken steps to make promptly available the results of observations at the second-order stations in the British Isles. These have heretofore been published in annual volumes which did not appear until four or five years after the period to which they referred.

Beginning with January, 1908, the results of twice-daily observations at 20 selected stations, together with observations of wind direction and velocity at anemograph stations, are publisht in monthly installments about six weeks after the completion of each month. The results for the remaining second-order stations (monthly values only), which have heretofore formed Part II of the annual volume, are now included in the Monthly and Annual Weather Reports, which are also issued quite promptly.

This change is in line with the policy now happily becoming general among the meteorological services of the world of making public the results of their observations with the least possible delay.

CLIMATE IN RELATION TO MAN.

Prof. Robert DeC. Ward's "Climate,"[3] separate chapters of which have appeared from time to time in various scientific journals, is now complete. Professor Ward has the knack of crystallizing ideas that are more or less "in the air" and presenting them in tangible form. The far-reaching effects of climate upon the mental and physical life of man, and hence upon human society and history, have been much to the fore in recent scientific literature; and Professor Ward's interesting book is a sort of *précis* of current views on that subject. After a brief account of climate in general, the author sketches the history of the division of the earth's surface into zones, from the time of the early Greek geographers; the more elaborate classifications of climate proposed in recent times by Supan,

[3] Ward, Robert DeCourcy. Climate considered especially in relation to man. New York: G. P. Putnam's Sons. (The science series, 20).

Köppen, Herbertson, and Ravenstein; the meteorological and biological characteristics of the zones; the hygiene of the zones; the conditions of human life in each zone; and, finally, the questions relating to changes of climate within historic times.

As Professor Ward deals mainly with the effects of *climate*, so Prof. Carl Kassner, of the Royal Prussian Meteorological Institute, in a little book brought out about the same time as above,[4] gives an interesting and up-to-date account of the effects of *weather* upon agriculture, commerce, transportation, communication, manufactures, health, mortality, crime, etc. (This subject is discussed in Part III; the rest of the book deals with the general subject of weather and weather forecasting.)

Both of these books are, as the French say, "full of actuality;" they summarize the most recent literature of the subjects treated, and their illustrations are largely drawn from events of recent occurrence.

CLOUDS OVER THE CHELSEA FIRE.

The formation of cumulus clouds over great conflagrations has frequently been reported. Features of special interest, however, were presented by the clouds observed over the fire at Chelsea, Mass., April 12, 1908, as described by Messrs. A. Lawrence Rotch and B. M. Varney in Science of May 15. Owing to the low relative humidity (14 per cent at Blue Hill Observatory) the heated air rose to a great height before condensation occurred, and the result was the formation of cumulus at an elevation of between four and five miles (i. e., four or five times the normal height of this form of cloud). Mr. Rotch notes, however, that in thunderstorms the cumulo-nimbus clouds rise into the cirrus level, and their tops have been measured at Blue Hill above eight miles.

TWENTY-FIFTH ANNIVERSARY OF THE GERMAN METEOROLOGICAL SOCIETY.

The German Meteorological Society (Deutsche Meteorologische Gesellschaft) is preparing to celebrate the completion of its twenty-fifth year of existence at the eleventh general meeting, to be held at Hamburg September 28, 29, and 30. All persons interested in meteorology are invited to attend. This society was founded at Hamburg in 1883, and has now 320 members. Its presiding officer is Doctor Hellmann, Director of the Prussian Meteorological Institute. The society is especially known to foreign meteorologists as the publisher, jointly with the Austrian Meteorological Society, of the Meteorologische Zeitschrift.

WIRELESS WEATHER REPORTS.

M. Angot, Director of the Bureau Central Météorologique, in a note communicated to the French Academy of Sciences, May 4, 1908, summed up the situation of the European meteorological services with respect to wireless weather reports from vessels on the Atlantic. The daily weather report of the British Meteorological Office now provides a small table for the wireless reports occasionally received from vessels of the British Navy. However, any further utilization of wireless reports by the European services is, for the moment, forbidden by financial considerations, altho the Marconi Company has offered to transmit such reports at a reduced tariff.

This recalls the situation of a few years ago with regard to the Iceland cable. As the financial difficulties were overcome in that case, we hope the European services will soon see their way to extend the field of their observations far to the westward by means of wireless messages. A committee was appointed at the Paris meeting of the International Meteorological Committee to investigate this subject, comprising Messrs. Shaw (chairman), Angot, Herz, Moore, and Rykachev.

A SUMMER CAMP OF METEOROLOGY.

We understand that some friends of the Weather Bureau are interested in a meteorological encampment—a summer school for meteorology—to be located in the beautiful and famous open glades of oak, cedar, and hickory on Cedar Heights, a bluff 100 feet above Cedar River, in Black Hawk County, between Waterloo and Cedar Falls, Iowa. This is not far from a permanent Chatauqua summer school, and we can not too strongly encourage this and all similar meteorological enterprises. The open air is the place for the enthusiastic observer of the atmosphere. Here alone he meets with frost and dew, rainbows, clouds and winds, the auroral tints of sunrise, and the twilight colors of sunset.

We recall vividly delightful hours spent during 1885–1890 at the camp of the Worcester Natural History Society. An hundred boys and teachers spent the summer in tents on Lake Quinsigamond. Instruction was given in every form of woodcraft and natural history. The editor's privilege was to talk about the clouds, how they are made, how high they are, how fast they move, what they mean as to past and future weather.

We bid godspeed to our Iowa colleagues, and hope the campers will send news of their work to the readers of the MONTHLY WEATHER REVIEW.

We hope other summer camp schools may be established in the interest of popular meteorological education.

[4] Kassner, Carl. Das Wetter und seine Bedeutung für das praktische Leben. Leipzig: Quelle and Meyer. 1906. (Wissenschaft und Bildung 25).

STÖRMER'S WORK ON THE PHYSICS OF THE AURORA.[1]

Reviewed by P. G. NUTTING. Reprinted from Terrestrial Magnetism and Atmospheric Electricity for March, 1908.

With the recent advances in our knowledge of luminescence and electrical effects in rarified gases, hypotheses of auroral formation have become fewer in number and more specific in detail. The spectroscope and transit long ago showed that the aurora is an excitation to luminescence of the upper portions of the earth's atmosphere. Further study with the spectroscope showed that the luminescence is such as could be caused only by a bombardment of cathode rays, corpuscles, or negative electrons, whatever they may be called. If the light had been caused by a steady current of electricity or by an electric wave it would be reddish orange instead of bluish white in color and would exhibit an altogether different spectrum. A disruptive discharge like lightning would produce a yellowish white light, with still a third spectrum composed of heavy lines instead of bands.

In order to account for the necessary cathode rays, Birkeland[2] in 1896 supposed them to be emitted by the sun much as they are emitted by a hot platinum wire or other heated body. Proceeding to the earth with about one-third the velocity of light, these particles would be entrapped by the earth's magnetic field and excite the outer atmosphere to luminescence.

Birkeland, however, did not consider his theory sufficient to account for the known structure and variability of the aurora. In 1900 he advanced a second theory[3] according to which he supposed the cathode rays produced within the atmosphere by other rays from the sun. In this manner he obtained more unknown variables as factors in the aurora, but left the matter in such an unsatisfactory state that three other theories of the aurora made their appearance.

Arrhenius[4] in 1900 supposed the necessary cathode rays to be produced in the earth's atmosphere by particles larger than molecules emitted by the sun and propelled by radiation pres-

[1] Carl Störmer. Sur les trajectoires des corpuscles électrises dans l'espace sous l'action du magnetisme terrestre avec application aux aurores boreales. Arch. Sc. Phys. Genève, July, August, September, October, 4 periode, v. 24, 1907, p. 140, with 2 pl. Compt. Rend., 142, 1580–1583; 143, 140–142, 1906. Cf. also Vol. IX, T. M., p. 149 and Carl Störmer: sur un probléme relatif au mouvement des corpuscles électriques dans l'espace cosmique, (Videnskabs-selskabets skrifter. I. Math.-naturv. Kl. 1907, No. 4) p. 10, 27½ by 18½. Kristiania 1907.

[2] K. Birkeland, Geneva Arch. des Sci. (4), 1, 497, 1896.

[3] K. Birkeland, Geneva Arch. des Sci. (4), 12, 478, 1901.

[4] Svante Arrhenius, Phys. Zeit., 2, 81, 97, 1901.

sure. Nordmann[5] in 1903 advanced the theory that they were produced by electric waves from the sun ionizing the upper atmosphere. Paulsen[6] later put forth a theory similar to the second of Birkeland's, but providing for an accumulation of "auroral material," a mixture of ionized air and cathode rays, produced by cathode rays and ultra violet light from the sun.

Finally Störmer, in the paper here under review, taking up Birkeland's first theory, worked out mathematically the trajectories of cathode rays projected into such a magnetic field as that of the earth. He showed that so great is the variation in path produced by slight differences in the velocity and original direction of such particles that Birkeland's simple first theory is ample to account for observed phenomena.

A negative electron projected into a magnetic field in an equatorial plane, moves in a curved path the form of that described by a point on a circle rolling on the inside of a larger circle. The stronger the magnetic field the smaller is the generating circle. Shot obliquely into a field, such a particle moves in a spiral path and if the field be convergent the spiral path is conical. The particle moves along the cone to where the field reaches a certain intensity and back again on another cone with its axis slightly displaced from the first. Störmer shows that in the earth's field the trajectory has the form of a wire wound on a cow's horn with its apex toward a magnetic pole.

Cathode rays would not be emitted freely at all times from all parts of the surface of the sun on account of the residual positive field. We should expect them to break forth in limited clouds during severe electrical storms in connection with sun spots. A small group just reaching the earth after sunset in winter would strike the earth's field tangentially in an oblique direction, move on a curved spiral path toward the North Pole, reverse and move toward the South Pole, again reverse and so on until absorbed by the atmosphere. On each trip north or south they would move in a different group of paths, hence the serrated structure of the simple aurora. Linear velocity and hence luminescence produced would be greatest at the north and south ends of the paths. The trip from north to south would occupy from about half a second to five seconds, according to the inclination and original velocity of the rays. This would be a plausible origin of the magnetic fluctuations observed during the smaller but more active displays.

More extended clouds of electrons from the sun would produce draped and diffused auroras. More intense displays might even be accompanied by ordinary electrical conduction and hence the reddish tints sometimes observed.

All things considered, the Birkeland-Störmer theory is by far the most satisfactory thus far advanced, both in its simplicity and in its explanation of widely varied phenomena. It is indeed the only theory thus far advanced that is free from radical objections.

RECENT ADDITIONS TO THE WEATHER BUREAU LIBRARY.

H. H. KIMBALL, Librarian.

The following titles have been selected from among the books recently received, as representing those most likely to be useful to Weather Bureau officials in their meteorological work and studies. Most of them can be loaned for a limited time to officials and employees who make application for them. Anonymous publications are indicated by a ——.

Alfani, Guido.
Primi appunti sul terremoto Calabrese del 23 ottobre 1907. [Estratto dalla Rivista di fisica, matematica e scienze naturali (Pavia). Anno 8, ottobre 1907, numero 94. 8p.]

American association for the advancement of science.
Proceedings... 56th and 57th meetings held at Ithaca, N. Y., June June 28 to July 3, 1906 (special summer meeting), and New York city, N. Y., December 27, 1906, to January 2, 1907. [Washington. 1908.] 677 p. 8°.

Annuaire officiel illustré de la Colonie du Congo . . . 1906.
Paris. vi, 223 p. 8°.

Association française pour l'avancement des sciences.
Compte rendu de la 36me session. Rheims. 1re partie. Paris. 1907. cx, 606 p. 8°.

Belgium. Observatoire royal de Belgique.
Annuaire météorologique pour 1908. Bruxelles. 1908. 488 p. 24°.

British association for the advancement of science.
Report. Leicester, 31 July-7 August, 1907. London. 1908. ccxix, 764 p. 8°.

Campbell, Norman Robert.
Modern electrical theory. Cambridge. 1907. xii, 322 p. 8°.

Church, J. E., jr.
Mount Rose weather observatory, 1905-1907. *In* Sierra club bulletin v. 6, June, 1907, p. 177-185.

Coimbra. Observatorio meteorologico.
Observaçoes meteorologicas e magneticas. 1904. v. 43. Coimbra. 1908. viii, 153 p. f°.
Same. 1905. v. 44. Coimbra. 1908. viii, 152 p. f°.

Fassig, Oliver Lanard.
The climate and weather of Baltimore. Baltimore. 1907. 515 p. 8°. (Maryland weather service. Special publication, v. 2.)

Flammarion, Camille.
Annuaire astronomique et météorologique pour 1908. 44 année. 1908. Paris. [1908.] 287 p. 16°.

France. Bureau central météorologique.
Annales. Année 1903. I. Mémoires. Paris. 1907. xvii, 232 p. f°.
Annales. Année 1904. II. Observations. Paris. 1907. A 272, B. 80, C 89 p. f°.

Ginestous, G.
Études sur le climat de la Tunisie. Tunis. 1906. 426, viii p.

Haines, Jennie Day.
Weather opinions; a book of quotations with interleaves on weather subjects. San Francisco. [1907.] 98, xxiii p. 8°.

Halbfass, W.
Klimatologische Probleme im Lichte moderner Seenforschung. Zweiter Teil. n. p. n. d. 26 p. 4°.

Hamburg. Deutsche Seewarte.
36er Jahresbericht... 1907. Hamburg. 1908. iv, 52 p. 4°.
Tabellarische Reisebericht nach den meteorologischen Schiffstagebüchern. 4. Band. Eingänge des Jahres 1906. Berlin. 1907. x, 221 p. 4°.

Hungary. K. ung. Reichsanstalt für Meteorologie und Erdmagnetismus.
Erdbeben in Ungarn im Jahre 1907. Budapest. 1908. 46, xxviii p. 8°.

Kassner, Karl.
Das Wetter und seine und Bedeutung für das praktische Leben. Leipzig. 1908. vi, 148 p. 12°. (Wissenschaft und Bildung. 20.)

Imperial Russian geographical society.
Otchet. 1905-1907. St. Petersburg. 1907-8. 8°.

Japan. Central meteorological observatory.
Amount of precipitation in each month and year since the commencement of the observation at 63 stations in Japan. Tokio. 1906. 46 p. f°.
Maximum daily amount of precipitation in each month and year since the commencement of the observation at 63 stations in Japan. Tokio. 1906. 46 p. f°.
Mean air temperature in each month and year since the commencement of the observation at 63 stations in Japan. Tokio. 1906. 46°. f°.
Number of days with precipitation in each month and year since the commencement of the observation at 63 stations in Japan. Tokio. 1906. 46 p. f°.

Krakau. K. k. Sternwarte.
Resultate der meteorologischen, seismologischen u. magnetischen Beobachtungen. 1907. Krakau. 1908. 10 p. 8°.

Krebs, Wilhelm.
Klimaschwankungen (Sonderabdruck aus der Zeitschrift für Socialwissenschaft. II. Bd. 4. Heft. 1908.)

Leipzig. Erdbebenstation des Paläontologisch-geologischen Institute.
9er Bericht. n. p. n. d. p. 57-78. (Abdruck aus den Berichten der Mathematisch-physischen Klasse der Königlich sächsischen Gesellschaft der Wissenschaften zu Leipzig. LX. Bd. Sitzung. vom 13. Januar 1908.)

Martonne, E. de.
Note préliminaire sur le vent d'autan. Montpellier. 1907. 17 p. 8°. (Extrait du Bulletin de la Société Languedocienne de geographie.)

Morgenroth, Hermann.
Ergebnisse fünfundzwanzigjähriger Witterungsbeobachtungen in Quakenbrück. 26 p. [Quakenbrück. 1906.] 4°. (Programm des Real-Gymnasiums zu Quakenbrück.)

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[5] C. Nordmann, J. de Ph., 3, 282, 1904.

[6] Adam Paulsen, Bull. Acad. Sci. Danemark, 2, 109, 1906. Cf. Vol. XII, T. M., p. 94.

Moscow. Agricultural institute. Meteorological observatory.
Observations. 1906. Moscow. 1908. xxiii, 72 p. 4°.

M'Pherson, J. G.
Meteorology; or, weather explained. London. 1905. viii, [9]-126 p. 12°.

Salisbury, Rollin D.
Physiography. New York. 1907. xx, 770 p. 8°. (American science series, advanced course.)

Société astronomique et météorologique de Port-au-Prince.
Bulletin annuel . . . année 1907. [Port-au-Prince.] 1908. [36], vi p. f°.

Southport. Fernley observatory.
Report and results of observations. 1907. Southport. 1908. 33 p. 8°.

Switzerland. Schweizerische meteorologische Central-Anstalt.
Annalen. Zürich. [1908]. v. p. f°.
Ergebnisse der täglichen Niederschlagsmessungen auf den meteorologischen- und Regenmess-Stationen in der Schweiz. Jahrg. 1901-1906. Zürich. [1903-1907.] f°.

Tokyo. University. College of science.
Journal. v. 24. Tokyo. 1908. viii, 113 p. 64 plates.

Ward, Robert DeCourcy.
Climate; considered especially in relation to man. New York. 1908. xiv, 372 p. 8°. (Science series.)

RECENT PAPERS BEARING ON METEOROLOGY AND SEISMOLOGY.

H. H. KIMBALL, Librarian.

The subjoined titles have been selected from the contents of the periodicals and serials recently received in the Library of the Weather Bureau. The titles selected are of papers or other communications bearing on meteorology or cognate branches of science. This is not a complete index of the meteorological contents of all the journals from which it has been compiled; it shows only the articles that appear to the compiler likely to be of particular interest in connection with the work of the Weather Bureau. Unsigned articles are indicated by a ——

Aeronautics. New York. v. 2. May, 1908.
Rotch, A. Lawrence. On the first observations with sounding balloons in America, obtained by the Blue Hill Observatory. p. 20-22.
Henry, Alfred J. The use of upper-air data in weather forecasting. p. 23-26.
Humphreys, W[illiam] J[ackson]. The possibility of extending our knowledge of the sun and of atmospheric absorption. p. 26-27.

American journal of science. New Haven. 4th ser. v. 25. May, 1908.
Bigelow, Frank H. The relations between the meteorological elements of the United States and the solar radiation. p. 413-430.

Geographical journal. London. v. 31. May, 1908.
Redway, Jacques W. Some after-lessons taught by the California earthquake. p. 518-522.

Imperial earthquake investigation committee. Bulletin. Tokyo. v. 2. no. 1.
Omori, F. On micro-tremors. p. 1-6.
Omori, F. Note on the Tokyo earthquake of Nov. 22, 1907. p. 7-12.
Omori, F. Horizontal pendulum record obtained at Mito during a storm. p. 13-16.
Omori, F. Note on the annual variation of seismic frequency in Tokyo and Kyoto. p. 17-20.
Omori, F. List of recent volcanic eruptions in Japan. p. 21-34.
Omori, F. On the annual variation of the height of sea-level along Japanese coasts. 2d paper. p. 35-50.
Omori, F. Note on the annual variation of the height of level of Lake Biwa. p. 51-57.
Omori, F. List of the stronger Japan earthquakes, 1902-1907. p. 58-88.

Indian forester. Allahabad. v. 34. Feb., 1908.
Henry M. [E.]. Forests and rainfall. p. 69-81.

Nature. London. v. 77. April 30, 1908.
Lowell, Percival. The presence of water vapor in the atmosphere of Mars. p. 606.
Rotch, A. Lawrence. The warm stratum in the atmosphere. p. 7.

Philippine journal of science. Manila. v. 3. Feb., 1908.
Ferguson, Henry G. Contributions to the physiography of the Philippine Islands: II. The Batanes Islands. p. 1-24.

Science. New York. New series. May 15, 1908.
Rotch, A. Lawrence. Very high cumulus clouds. p. 783.
Varney, B. M. Clouds over a fire. p. 783-784.

Scientific American. New York. v. 98. May 9, 1908.
Wade, Herbert T. Gas phosphorescence and meteor trains. p. 329-330.

Scientific American supplement. New York. v. 65. May 9, 1908.
—— Protecting vines or fruit trees. p. 296-298.
—— Caisson disease. The ills of compressed air. p. 326-327.

Scottish meteorological society. Journal. Edinburgh. v. 24. April, 1908.
Watt, Andrew. The climate of the British Isles. p. 169-186.

Symons's meteorological magazine. London. v. 43. April, 1908.
[Mill, Hugh Robert.] The geographical distribution of rainfall in the British Isles. p. 45-50.
Bonacina, L. C. W. Notes on some great frosts in recent winters. p. 50-53.

Observatoire royal de Belgique. Annuaire météorologique 1908. Bruxelles. 1908.
V[incent], J. La transpiration pulmonaire en Belgique et au Congo. p. 453-458.
—— Les hautes pressions de Janiver 1907 en Europe. p. 459-461.
V[incent], J. Humidité et sensation thermique. p. 462-472.
V[incent], J. Nouvel atlas des nuages. p. 473-476.
V[incent], J. Ascensions de ballons-sondes en Belgique. p. 477-483.

Ciel et terre. Bruxelles. 29 année. 16 avril 1908.
—— Influence météorologique de l'année 1907 sur le chant des oiseaux. p. 100-104.
Rudaux, Lucien. L'aurore boréale du 26 mars. p. 319-320.

Société belge d'astronomie. Bulletin. Bruxelles. 13 année. Mars, 1908.
Arctowski, Henryk. Notice sur les variations de longue durée des amplitudes moyennes de la marche diurne de la température en Russie. p. 89-102.
Arctowski, H[enryk]. Variation des amplitudes des marches diurnes de la température au sommet du Pike's Peak. p. 102-105.
Trowbridge, C. C. La constitution physique des trainées météoriques. p. 145-152.

Annalen der Hydrographie und maritimen Meteorologie. Berlin. 36 Jahrgang. 1908.
Grossman, —. Die stürmischen Winde an der deutschen Küste vom 1. bis 12. Januar 1908. p. 189-200.
Steffens, O. Ein neuer Windrichtungs-Autograph. p. 208-211.

Meteorologische Zeitschrift. Braunschweig. Band 25. April, 1908.
Sprung, A. Die registrierende Laufgewichtswage im Dienste der Schnee-, Regen- und Verdunstungsmessung. p. 145-154.
Kähler, Karl. Registrierungen des luftelektrischen Potentialgefälles an nahe benachbarten Stationem. p. 155-162.
Weber, Oswald Benno. Das Observatorium erster Ordnung zu Quixeramobim, Staat Ceará (Nordbrazilien). Ergebnisse der Meteorologischen Beobachtungen 1896 bis 1905. p. 162-167.
Woeikow, A. Zur Kenntnis des Regenfalles en Niederländisch-Indien. p. 168-174.
Wegrosta, K. Ostalpenföhn und die Föhnperiode Oktober 1907. p. 174-175.
Defant, A. Ueber die Beziehung zwischen Druck und Temperatur bei mit der Höhe variabeln Temperaturgradienten. p. 175-178.
Sapper, Karl. Meteorologische Beobachtungen, angestellt in den Republiken Guatemala und Salvator 1906. p. 178-181.
Uljanin, W. v. Ueber den Assmannschen Aspirations-meteorographen. p. 182-183.
—— Nebel und Stürme am Baikalsee. p. 183-185.
Woeikow, A. Das Barometermaximum November 1907 in Russland. p. 185-186.
Schreiber, Paul. Formeln und Tabellen aus dem Gebiete der Thermodynamik, für die meteorologische Praxis vorgerichtet. [Review.] p. 187-190.
Heidke, P. Täglicher Gang des Luftdrucks und der Temperatur zu Windhuk vom Juli 1902 bis Juni 1906 wie seine harmonischen Konstituenten. p. 35-40.

Mitteilungen aus den deutschen Schutzgebieten. Berlin. 21. Band. 1908.
Heidke, P. Meteorologische Beobachtungen aus Deutsch-Ostafrika. Teil III. Zusammenstellungen von Monats- und Jahresmitteln aus den Jahren 1903 und 1904 an 25 Beobachtungsstationen. p. 41-104.

Petermanns Mitteilungen. Gotha. 54. Bd., 1908.
Knörzer, A. Temperaturanomalien in Mitteleuropa, hervorgerufen durch südöstliche und südwestliche Maxima. p. 57-60.

Physikalische Zeitschrift. Leipzig. 9 Jahrgang. 1. Mai 1908.
Gockel, A. Ueber den Gehalt der Bodenluft an radioactiver Emanation. p. 304-306.

Zeitschrift der Gesellschaft für Erdkunde. Berlin. 1908.
Holdefleiss, —. Ueber die Sonnendauer in Deutschland. p. 208-209.

Sociedade de geographia de Lisboa. Boletim. Lisboa. 26 série-1908.
Gomes de Sousa, Ernesto Augusto. Resumé das observaçoes do anno de 1907 no Observatorio de Loanda. p. 16-17.

THE WEATHER OF THE MONTH.

By Mr. P. C. DAY, Assistant Chief, Division of Meteorological Records.

PRESSURE.

The distribution of mean atmospheric pressure for April, 1908, over the United States and Canada, is graphically shown on Chart VI, and the average values and departures from the normal are shown for each station in Tables I and III.

During April there is normally a sharp decrease in the average atmospheric pressure from that of March over all interior districts of Canada and over the interior and southern portions of the United States, due to the advance northward and eastward of the more or less permanent summer type of low pressure intruding from the vicinity of the Gulf of California. Over the Pacific coast districts from northern California to British Columbia there is a slight increase of pressure during April over that of March, due to the advance eastward of the high-pressure area normal during the summer over that portion of the Pacific, and over the St. Lawrence Valley and the Maritime Provinces of Canada and northern New England there is also a slight increase due to the drifting eastward toward Hudson Bay of the remnant of the high-pressure area that usually covers the interior portions of the United States and Canada during the winter months.

During April, 1908, the usual increase in pressure was maintained over British Columbia and the northern portions of Washington and Idaho, but over the remaining districts of the United States and Canada pressure diminished from that of March by well-marked amounts, especially over the more eastern districts, where the decrease from the preceding month amounted to as much as 0.30 inch.

Pressure averaged above the normal generally from the Great Plains westward to the Pacific, except over most of central and southern California, while over the greater part of Canada and in all districts of the United States east of the Missouri and Mississippi valleys the pressure for the month was lower than the average, the departure from the normal being most pronounced over the St. Lawrence Valley.

The general distribution of pressure was such as to give a preponderance of southerly winds over all southern districts from the southern Plateau region eastward to the Atlantic and northerly winds over the upper Lake region and thence westward to the northern Rocky Mountain district.

Storm activity was above the normal along the northern border and from the east Gulf States northeastward over the Atlantic coast States and New England, where the wind movement ranged from 10 to 30 per cent greater than the average.

Over the lower Mississippi Valley and thence westward to the Pacific there was generally less than the usual storm activity, the wind movement ranging from 10 to 30 per cent less than the average.

TEMPERATURE.

The month opened with a cold wave of considerable severity, advancing southeastward over the Missouri Valley, which during the 2d and 3d overspread the Mississippi Valley and Atlantic coast district. Temperatures below freezing occurred as far south as the northern portion of the Gulf States and readings below zero were recorded in North Dakota and eastern Montana. Another moderately cold wave pursued a similar course from the 15th to 17th, and near the end of the month cold weather again prevailed along the eastern slope of the Rocky Mountains, extending to the Texas panhandle and the middle Mississippi and Arkansas valleys.

Aside from the above the month was uniformly warm for the season, and in marked contrast with the same month of 1907, which was one of the coldest on record, over the districts east of the Rocky Mountains.

The mean temperature for the month was above the normal over all districts in the United States and Canada, except small areas on the northwest coast, in western Texas and eastern New Mexico, and over the lower Lake region, northern New England, and the Eastern Provinces of Canada.

The average temperature for the month was unusually high over the south Atlantic and east Gulf districts, ranging from 4° to 6° above the normal. At points in northern Florida and surrounding districts it was the warmest April in the history of the Weather Bureau.

The average temperature was also high over the Missouri Valley, northern Rocky Mountain districts, and thence southwesterly to the middle Pacific coast, ranging from 2° to 5° above the seasonal average, and marking the seventh consecutive month with mean temperatures above the normal. Over the districts last mentioned the average temperatures for the respective months have remained above the normal continuously since October, 1907, the accumulated excess during that period ranging from 2° to nearly 6° per day.

Slight deficiencies prevailed over northwestern Washington, western Texas, and eastern New Mexico, the lower Lake region, and northern New England. Maximum temperatures of 90° or slightly higher occurred over portions of the South Atlantic and east Gulf States, the Dakotas, and eastern Montana, southwestern Texas, southern Arizona, and the interior valleys of southern California.

Minimum temperatures of 32°, or lower, occurred over the districts from southern Maryland southwestward to northern Georgia, and thence westerly over the northern portion of the cotton-growing States to western Texas. Freezing temperatures were not recorded over the southern portion of Arizona nor over the lower elevations of California. The lowest temperatures, from −5° to −10°, occurred over eastern Montana and northern North Dakota, while over the high elevations of the Rocky Mountain districts the minimum temperatures were generally above the zero point, a very unusual condition for April.

PRECIPITATION.

The distribution of precipitation during April, 1908, is graphically shown on Chart IV by appropriate shading or by figures representing the actual amount of fall over districts, the topography of which is too varied to admit of approximately correct shading.

The precipitation for the month was generally above 4 inches over the most of Texas and Oklahoma and thence eastward over the Gulf States and Ohio Valley to the Appalachian Mountains and central Georgia.

The amounts over portions of eastern Oklahoma, the southern portions of Mississippi and Alabama, central Georgia, and locally in Florida, ranged from 6 to 10 inches.

From the New England and Middle Atlantic States westward to the Mississippi and Missouri valleys the total fall for the month ranged from 2 to 4 inches. Over the Great Plains, mountain, Plateau, and Pacific coast districts the monthly precipitation was generally less than 1 inch, except near the coasts of Oregon and Washington and on the western slopes of the mountains of Washington, and locally in the mountains of Oregon and northern California, where amounts from 2 to 4 inches occurred.

Over the districts east of the Appalachian Mountains, from New England to North Carolina, there was a general deficiency in precipitation, also locally at points in southern Louisiana and eastern Texas, and there was a general and well-marked deficiency over nearly all portions of the Missouri Valley, mountain, Plateau, and Pacific coast districts. Over the greater part of California and western Oregon the month was unusually dry, and similar conditions prevailed over much of the Plateau and mountain regions.

Over the districts between the Mississippi Valley and the Appalachian Mountains, along the Gulf coast, and over most of Texas, Arkansas, and Oklahoma, the precipitation was generally above the normal and well distributed thru the various portions of the month.

Over portions of central Texas, eastern Oklahoma, northwestern Arkansas, the southern portions of Mississippi and Alabama, western Georgia, and locally in Florida, the precipitation ranged from 4 to 9 inches above the average.

Severe thunderstorms, accompanied by high winds, tornadoes, and heavy rainfall, occurred at numerous points in the States of Louisiana and Mississippi during the 23d and 24th, resulting in the loss of many lives and much damage to property. A full account of the more severe storms of the above dates, with details of the loss of life, property, etc., will appear in the Review for May, 1908.

SNOWFALL.

The area over which snowfall occurred and the monthly amounts are shown on Chart VII.

In general the monthly amounts were much below the normal, except over the northern portions of Michigan and Wisconsin and central Minnesota, where amounts from 5 to 20 inches occurred.

A rather remarkable snowstorm for so late in the season prevailed on the 30th over central and eastern Ohio, in the mountains of western Pennsylvania and in parts of West Virginia, where depths ranging from 2 to 15 inches occurred.

Over the mountain districts of the West there was a very general and pronounced deficiency in the amount of snowfall; even on the highest mountains but little snow occurred.

The general deficiency in snowfall thruout the winter and the unusual warmth that has prevailed over the mountain districts since October has prevented any large accumulations of snow, and the visible supply of water at the end of the month was generally below the average.

HUMIDITY AND SUNSHINE.

The relative humidity was above the normal from New Mexico eastward over Texas and the Gulf States, and generally east of the Mississippi River, except over the Appalachian Mountain region, where a slight deficiency prevailed.

From New Mexico eastward to the Mississippi River and from the Mexican boundary northward to southern Kansas and Missouri, the excess was marked, ranging from 5 to more than 20 per cent.

From the upper Mississippi Valley westward to the Pacific there was a general deficiency in the average relative humidity, except locally in the central portions of Nevada, Oregon, and Washington.

Much cloudy weather prevailed over the districts east of the Mississippi Valley, and over the Plains region from Kansas and Colorado southward. From the upper Mississippi Valley westward to the Pacific, including the whole of California, there was much less than the normal amount of clouds, the percentage of sunshine ranging from 50 to 80 per cent of the possible.

In Canada.—Director R. F. Stupart says:

The mean temperature for April was above the average from the Thunder Bay district of Ontario to the Rocky Mountains, whilst elsewhere in Canada it was subnormal. In southern districts of the Western Provinces positive departures of 3° were general, while over a large portion of Ontario, Quebec, and the Maritime Provinces, the negative difference from the average was more than 3°, and in the Ottawa Valley was from 5° to 7°.

The amount of precipitation recorded during April was much less than the average from British Columbia to eastern Manitoba, except very locally in Alberta, where the fall was slightly in excess of the normal; while in Ontario, Quebec, and the Maritime Provinces a supernormal amount was recorded, except in central and eastern counties of Ontario, where the amount was less than the usual. The precipitation was partly snow in most districts.

Average temperatures and departures from the normal.

Districts.	Number of stations.	Average temperatures for the current month.	Departures for the current month.	Accumulated departures since January 1.	Average departures since January 1.
		°	°	°	°
New England	12	43.2	— 0.6	+ 0.2	0.0
Middle Atlantic	16	53.5	+ 2.7	+ 4.9	+ 1.2
South Atlantic	10	66.1	+ 4.8	+ 7.3	+ 1.8
Florida Peninsula*	8	75.8	+ 5.6	+ 7.1	+ 1.8
East Gulf	11	68.9	+ 4.3	+ 8.0	+ 2.0
West Gulf	10	67.0	+ 1.5	+12.6	+ 3.2
Ohio Valley and Tennessee	13	56.7	+ 1.7	+ 7.3	+ 1.8
Lower Lake	10	44.4	— 0.3	+ 0.9	+ 0.2
Upper Lake	12	41.6	+ 1.2	+ 8.2	+ 2.0
North Dakota*	9	44.2	+ 3.0	+23.1	+ 5.8
Upper Mississippi Valley	15	51.3	+ 0.8	+13.5	+ 3.4
Missouri Valley	12	52.9	+ 2.4	+21.9	+ 5.5
Northern Slope	9	46.0	+ 3.3	+15.0	+ 3.8
Middle Slope	6	54.6	+ 0.9	+19.0	+ 4.8
Southern Slope*	7	60.8	— 0.6	+12.6	+ 3.2
Southern Plateau*	12	58.4	+ 0.6	+ 5.7	+ 1.4
Middle Plateau*	10	48.7	+ 1.7	+ 7.0	+ 1.8
Northern Plateau*	12	49.0	+ 2.0	+ 9.3	+ 2.3
North Pacific	7	48.4	0.0	+ 3.1	+ 0.8
Middle Pacific	8	57.4	+ 2.0	+ 3.3	+ 0.8
South Pacific	4	60.6	+ 2.5	+ 6.2	+ 1.6

* Regular Weather Bureau and selected cooperative stations.

Average precipitation and departures from the normal.

Districts.	Number of stations.	Average. Current month.	Average. Percentage of normal.	Departure. Current month.	Departure. Accumulated since Jan. 1.
		Inches.		*Inches.*	*Inches.*
New England	12	2.27	74	—0.8	—1.8
Middle Atlantic	16	2.44	80	—0.6	—1.2
South Atlantic	10	3.06	88	—0.4	—1.3
Florida Peninsula*	8	2.74	134	+0.7	—3.4
East Gulf	11	5.26	130	+1.2	+0.4
West Gulf	10	5.00	139	+1.1	—0.1
Ohio Valley and Tennessee	13	4.43	122	+0.8	+0.7
Lower Lake	10	3.11	135	+0.8	+1.8
Upper Lake	12	2.94	126	+0.6	+0.9
North Dakota*	9	1.42	88	—0.2	+0.5
Upper Mississippi Valley	15	3.50	117	+0.5	+0.1
Missouri Valley	12	2.68	87	—0.2	—0.3
Northern Slope	9	0.73	48	—0.8	—1.1
Middle Slope	6	1.86	82	—0.4	—1.2
Southern Slope*	7	4.10	171	+1.7	+0.7
Southern Plateau*	12	0.91	149	+0.3	+0.2
Middle Plateau*	10	0.80	57	—0.6	—1.5
Northern Plateau*	12	0.62	51	—0.6	—2.4
North Pacific	7	2.90	88	—0.4	—1.8
Middle Pacific	8	0.31	14	—1.9	—3.5
South Pacific	4	0.45	43	—0.6	—0.9

Maximum wind velocities.

Stations.	Date.	Velocity.	Direction.	Stations.	Date.	Velocity.	Direction.
Amarillo, Tex	25	60	n.	Mount Weather, Va	2	53	nw.
Block Island, R. I	3	64	nw.	Do	3	50	nw.
Do	4	50	w.	Do	11	59	nw.
Do	9	54	nw.	Do	12	50	nw.
Do	11	54	w.	Do	19	52	nw.
Do	12	58	nw.	Do	20	53	nw.
Do	21	50	nw.	Do	30	75	nw.
Buffalo, N. Y	2	54	w.	New Haven, Conn	11	50	w.
Do	11	55	w.	New York, N. Y	2	56	nw.
Burlington, Vt	2	60	s.	Do	3	50	w.
Do	15	50	s.	Do	11	60	w.
Canton, N. Y	2	55	w.	North Head, Wash	16	85	se.
Do	11	54	w.	Do	17	66	se.
Cape Henry, Va	16	50	ne.	Do	23	53	s.
Cheyenne, Wyo	24	50	nw.	Oklahoma, Okla	24	59	nw.
Chicago, Ill	25	52	w.	Do	28	58	n.
Cleveland, Ohio	20	54	w.	Pierre, S. Dak	14	51	nw.
Detroit, Mich	2	50	w.	Point Reyes Light, Cal	3	61	nw.
Do	11	54	w.	Do	4	57	nw.
Do	25	50	sw.	Do	5	64	nw.
Duluth, Minn	10	55	nw.	Do	6	80	nw.
Do	14	54	nw.	Do	24	50	nw.
El Paso, Tex	26	54	ne.	Sheridan, Wyo	24	50	nw.
Escanaba, Mich	27	56	e.	Sioux City, Iowa	1	50	nw.
Green Bay, Wis	15	52	ne.	Do	25	50	nw.
Hatteras, N. C	16	51	ne.	Southeast Farallon, Cal	6	59	nw.
Jacksonville, Fla	30	51	sw.	Syracuse, N. Y	1	54	s.
Lewiston, Idaho	24	56	w.	Do	11	54	w.
Memphis, Tenn	26	61	w.	Tatoosh Island, Wash	17	60	s.
Modena, Utah	6	50	sw.	Toledo, Ohio	2	50	sw.
Mount Tamalpais, Cal	1	52	n.	Do	25	60	sw.
Do	5	54	nw.	Valentine, Nebr	26	51	nw.
Do	6	58	nw.	Williston, N. Dak	25	50	w.
Do	7	54	n.				

Average relative humidity and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
	%			%	
New England	69	— 4	Missouri Valley	52	— 3
Middle Atlantic	68	+ 1	Northern Slope	58	— 2
South Atlantic	74	+ 2	Middle Slope	59	+ 2
Florida Peninsula	80	+ 6	Southern Slope	63	+ 8
East Gulf	76	+ 6	Southern Plateau	42	+12
West Gulf	77	+ 5	Middle Plateau	46	+ 1
Ohio Valley and Tennessee	67	+ 2	Northern Plateau	50	— 7
Lower Lake	70	0	North Pacific	77	+ 6
Upper Lake	72	— 1	Middle Pacific	64	— 8
North Dakota	66	— 2	South Pacific	65	— 3
Upper Mississippi Valley	67	— 1			

Average cloudiness and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
New England	5.1	— 0.2	Missouri Valley	5.1	— 0.3
Middle Atlantic	4.8	— 0.4	Northern Slope	4.2	— 1.2
South Atlantic	5.1	+ 0.7	Middle Slope	5.2	+ 0.8
Florida Peninsula	3.0	— 0.9	Southern Slope	5.1	+ 0.9
East Gulf	5.8	+ 1.3	Southern Plateau	2.7	+ 0.4
West Gulf	5.6	+ 0.4	Middle Plateau	3.3	— 1.2
Ohio Valley and Tennessee	5.8	+ 0.5	Northern Plateau	3.9	— 2.4
Lower Lake	6.0	+ 0.5	North Pacific	5.8	— 0.7
Upper Lake	5.9	+ 0.2	Middle Pacific	3.5	— 1.1
North Dakota	5.0	— 0.5	South Pacific	2.5	— 1.4
Upper Mississippi Valley	5.2	— 0.3			

CLIMATOLOGICAL SUMMARY.

By Mr. JAMES BERRY, Chief of the Climatological Division.

TEMPERATURE AND PRECIPITATION BY SECTIONS, APRIL, 1908.

In the following table are given, for the various sections of the Climatological Service of the Weather Bureau, the average temperature and rainfall, the stations reporting the highest and lowest temperatures with dates of occurrence, the stations reporting greatest and least monthly precipitation, and other data, as indicated by the several headings.

The mean temperatures for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperature and precipitation are based only on records from stations that have ten or more years of observation. Of course the number of such records is smaller than the total number of stations.

Section.	Temperature—in degrees Fahrenheit.								Precipitation—in inches and hundredths.					
	Section average.	Departure from the normal.	Monthly extremes.						Section average.	Departure from the normal.	Greatest monthly.		Least monthly.	
			Station.	Highest.	Date.	Station.	Lowest.	Date.			Station.	Amount.	Station.	Amount.
Alabama	66.9	+ 4.2	Evergreen	94	6	Riverton	26	4	5.84	+ 1.79	Thomasville	12.25	Livingston	2.70
Arizona	61.0	— 0.1	Casagrande Parker	102 102	28 12	Williams	13	2	0.60	+ 0.13	Natural Bridge	2.73	Parker	0.00
Arkansas	63.3	+ 1.9	Warren	93	8	Bergman	24	30	6.32	+ 2.14	Mena	13.76	Helena (No. 1)	2.56
California	58.4	+ 2.1	Mammoth Tank	104	30	Tamarack	4	12	0.67	— 1.31	Monumental	5.28	10 stations	0.00
Colorado	44.2	+ 1.2	Las Animas	90	22	Hahns Peak	— 6	4	0.90	— 1.12	2 stations	4.27	Eads	0.00
Florida	75.4	+ 6.3	3 stations	99	3 d't's	Macclenny	37	4	3.34	+ 0.87	Clermont	11.35	Key West	0.18
Georgia	67.5	+ 4.7	3 stations	95	10	Clayton	27	4	6.89	+ 3.70	Marshallville	13.91	Valdosta	1.15
Hawaii	69.8†		Kihei, Maui	89	4, 6, 9	Humuula, Hawaii	32	3 dates	5.88‡		Olaa, Hawaii	28.06	2 stations	0.00
Idaho	46.7	+ 2.1	Orofino	92	19	Lake	— 6	2	0.83	— 0.37	Landore	3.15	Mackay	T.
Illinois	52.4	+ 0.7	Chester	93	20	Lanark Zion	19 19	2 3	4.41	+ 1.11	Chester	8.86	Yorkville	1.55
Indiana	52.7	+ 0.6	Rome	87	22	Fort Wayne	18	4,5	4.37	+ 1.22	Rome	8.40	Auburn	2.37
Iowa	50.5	+ 2.0	Onawa	91	19	Fort Dodge	8	2	2.24	— 0.59	Inwood	4.59	Little Sioux	0.67
Kansas	56.1	+ 1.0	Coolidge	93	22	Wallace	8	2	2.06	— 0.53	Columbus	6.86	Scott	0.07
Kentucky	59.8	+ 1.8	Marion	89	25	Shelby City Williamstown	23 23	3 3	6.56	+ 3.10	Frankfort	8.61	Williamsburg	3.40
Louisiana	71.7	+ 4.9	Baton Rouge	96	11	Minden	36	30	4.17	— 0.22	Simmesport	8.29	New Orleans	1.34
Maryland and Delaware	54.6	+ 2.9	Cambridge, Md	90	26	Oakland, Md	19	3	2.36	— 0.86	Deer Park, Md	4.68	Taneytown, Md	1.07
Michigan	43.2	+ 0.6	East Tawas	89	22	Humboldt	—13	3	2.53	+ 0.36	Grand Rapids	4.87	Baraga	0.75
Minnesota	45.2	+ 1.8	Halstad	93	21	Hallock	— 3	2	2.55	+ 0.40	Winnebago	4.55	Halstad	0.58
Mississippi	68.6	+ 4.6	Hattiesburg	92	9	Ripley	30	4	5.28	+ 1.11	Waynesboro	15.09	Enterprise	1.98
Missouri	56.6	+ 1.2	Linneus, Warsaw	90	20	3 stations	18	2	5.30	+ 1.68	Greenville	12.44	Linneus	0.37
Montana	45.4	+ 2.9	Forsythe	93	20	Chinook	—13	1	0.89	— 0.39	Snowshoe	4.91	2 stations	T.
Nebraska	51.5	+ 2.4	Halsey	96	22	Hay Springs	— 1	2	1.26	— 1.35	Norfolk	3.43	2 stations	T.
Nevada	50.1	+ 3.0	Las Vegas Logan	91 91	13 18, 19	Quinn River Ranch	4	1	0.33	— 0.44	Battle Mountain	1.75	2 stations	0.00
New England*	42.8	— 0.6	Norfolk, Mass	90	23	Van Buren, Me	— 4	10	2.28	— 0.61	Woodstock, Vt	4.39	Southington, Conn	1.10
New Jersey	51.2	+ 1.8	Browns Mills	93	26	Layton	13	5	2.72	— 0.72	Charlottesburg	3.86	Pleasantville	1.42
New Mexico	52.3	+ 0.1	Monument	90	8, 9	Vermejo Park	8	5	1.51	+ 0.46	Red River	4.40	Cliff	0.11
New York	43.2	— 0.4	Athens	88	23	Keepewa	— 5	5	2.89	+ 0.25	Baldwinsville	5.82	Chazy	0.45
North Carolina	62.1	+ 4.4	Lumberton	92	11	3 stations	23	3, 4	3.12	— 0.66	Sapphire	7.63	Louisburg	1.06
North Dakota	43.9	+ 2.6	Amenia, Mayville	91	21	White Earth	—19	6	1.47	— 0.11	Gladys	3.76	Melville	0.12
Ohio	51.0	+ 1.4	Demos	91	24	Garrettsville	16	4	3.69	+ 0.82	Coalton	6.80	Hedges	1.65
Oklahoma	60.0	0.0	Okeene	92	17	Kenton	19	2	5.11	+ 2.43	Meeker	10.99	Buffalo	0.83
Oregon	50.2	+ 1.5	Dayville	92	11	Christmas Lake	9	4	1.81	— 0.97	Glenora	11.07	Lake View	0.00
Pennsylvania	49.8	+ 1.5	3 stations	89	24	Pocono Lake	0	16	3.51	+ 0.48	Drifton	6.31	Hanover	1.85
Porto Rico	74.7		Bayamon	93	22, 25	Aibonito	51	20	3.88		San Sebastian	11.54	Santa Isabel	0.40
South Carolina	66.6	+ 4.9	Walterboro	95	10	Liberty	31	4	4.75	+ 1.38	Bowman	8.48	Camden (2)	1.42
South Dakota	49.0	+ 3.0	Armour	97	14	Bowdle Ottumwa	— 1 — 1	2 2	2.00	— 0.13	Clear Lake	4.43	Hermosa	0.32
Tennessee	62.1	+ 3.9	Pope	90	26	Erasmus	18	4	5.88	+ 1.28	Kenton	8.25	Seiverville	2.20
Texas	67.0	+ 0.5	Fort McIntosh Tilden	100 100	2, 8 25	Plemons	21	2	5.08	+ 2.03	Dublin	12.78	Fort McIntosh	0.78
Utah	49.4	+ 2.1	St. George	89	13, 28	Henefer Morgan	1 1	1 1	0.49	— 0.80	Pinto	2.10	2 stations	0.00
Virginia	57.3	+ 3.8	Arvonia	93	24	Blacksburg Burkes Garden	20 20	3 3	2.81	— 0.48	Burkes Garden	5.53	Riverton	0.40
Washington	49.4	+ 0.7	Zindel	90	19	Republic	15	1	2.23	— 0.24	Clearwater	10.72	2 stations	T.
West Virginia	54.8	+ 3.4	4 stations	92	24	Pickens	18	3	4.30	+ 0.55	Logan	8.02	Upper Tract	0.77
Wisconsin	45.2	+ 0.8	Manitowoc	87	22	Long Lake	— 9	3	3.48	+ 1.04	Downing	5.45	Menasha	1.67
Wyoming	43.2	+ 3.2	Basin	87	20	Norris, Y. N. P	—19	2	0.89	— 0.52	Pine Bluff	3.18	2 stations	T.

* Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut. † 51 stations, with an average elevation of 710 feet. ‡ 147 stations.

DESCRIPTION OF TABLES AND CHARTS.

By Mr. P. C. DAY, Assistant Chief, Division of Meteorological Records.

For description of tables and charts see page 8 of REVIEW for January, 1908.

TABLE I.—*Climatological data for U. S. Weather Bureau stations, April, 1908.*

Stations.	Elevation of instruments.			Pressure, in inches.			Temperature of the air, in degrees Fahrenheit.												Precipitation, in inches.			Wind.									
	Barometer above sea level, feet.	Thermometers above ground.	Anemometer above ground.	Actual, reduced to mean of 24 hours.	Sea level, reduced to mean of 24 hrs.	Departure from normal.	Mean max. + mean min. ÷ 2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.	Mean wet thermometer.	Mean temperature of the dew-point.	Mean relative humidity, per cent.	Total.	Departure from normal.	Days with .01, or more.	Total movement, miles.	Prevailing direction.	Maximum velocity. Miles per hour.	Maximum velocity. Direction.	Maximum velocity. Date.	Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness during daylight, tenths.	Total snowfall.
New England.							43.2	− 0.6										69	2.27	− 0.8										5.1	
Eastport	76	69	85	29.71	29.80	− .13	37.0	− 1.3	65	23	45	11	4	29	28	33	28	75	2.64	− 0.3	14	10,445	w.	44	w.	12	5	16	9	5.9	14.9
Greenville	.....	.....	.....	.....	.....	.....	32.9	.....	73	26	43	2	4	23	.....	.....	.....	.....	2.14	.....	9	.....	nw.	.....	.....	.....	.....	.....	.....	.....	.....
Portland, Me.	103	81	117	29.74	29.87	− .09	40.6	− 2.4	81	26	49	18	4	32	38	35	26	60	2.14	− 1.0	13	9,007	w.	45	nw.	12	9	12	9	5.3	4.5
Concord	288	70	79	29.57	29.88	− .11	42.4	− 1.4	80	26	53	17	4	32	47	.....	.....	.....	1.85	− 0.9	14	5,925	nw.	36	w.	11	19	7	4	3.1	7.5
Burlington	404	12	47	29.46	29.91	− .08	38.6	− 4.8	77	27	48	12	4	30	31	.....	.....	.....	1.93	+ 0.1	13	10,889	s.	60	s.	2	8	9	13	6.1	4.3
Northfield	876	16	70	28.92	29.89	− .10	37.4	− 2.8	78	27	48	9	4	27	39	34	29	70	2.20	+ 0.1	16	8,568	nw.	48	se.	2	5	12	13	6.6	7.7
Boston	125	115	188	29.75	29.89	− .08	46.8	+ 1.5	85	23	56	24	4	38	31	42	37	73	1.70	− 1.8	15	9,491	nw.	45	w.	11	9	11	10	5.3	0.8
Nantucket	12	14	90	29.89	29.90	− .07	43.7	− 0.5	62	26	50	26	4	37	20	41	38	84	3.55	+ 0.9	17	13,959	sw.	49	sw.	15	12	10	8	5.5	T.
Block Island	26	11	46	29.89	29.92	− .06	44.4	+ 0.6	64	26	50	26	4	38	17	40	34	73	2.64	− 1.0	15	14,965	sw.	64	nw.	3	14	10	6	4.2	T.
Narragansett	.....	9	.....	.....	.....	.....	45.0	+ 0.4	66	26	54	21	5	36	28	.....	.....	.....	2.64	.....	12	.....	nw.	.....	.....	.....	18	5	7	.....	T.
Providence	160	57	67	29.74	29.92	− .06	46.6	0.0	85	23	56	22	5	37	35	39	31	59	1.77	− 1.8	13	7,112	w.	36	nw.	9	15	9	6	4.2	T.
Hartford	159	122	132	29.74	29.92	− .07	48.2	+ 1.5	85	23	58	22	4	38	29	41	33	60	2.36	− 1.2	12	7,447	nw.	42	nw.	12	10	11	9	5.5	T.
New Haven	106	116	155	29.81	29.93	− .06	48.2	+ 1.8	81	26	58	24	5	39	32	41	34	63	2.15	− 1.4	13	8,473	nw.	50	w.	11	13	10	7	4.4	T.
Mid. Atlantic States.							53.5	+ 2.7										68	2.44	− 0.6										4.8	
Albany	97	102	115	29.81	29.92	− .08	45.6	− 0.2	82	26	55	21	4	36	36	40	33	63	2.62	+ 0.2	14	7,418	s.	38	se.	30	11	10	9	5.0	0.4
Binghamton	871	78	90	29.00	29.94	− .08	44.6	+ 0.2	81	24	55	18	5	34	41	.....	.....	.....	2.96	+ 0.7	13	6,274	nw.	39	w.	11	6	9	15	6.5	1.1
New York	314	108	350	29.59	29.93	− .07	50.6	+ 2.5	79	26	59	27	5	42	24	45	40	74	1.82	− 1.5	10	11,279	nw.	60	w.	11	13	11	6	4.5	T.
Harrisburg	374	94	104	29.56	29.96	− .06	52.4	+ 1.7	83	27	63	28	5	42	34	45	36	59	2.33	− 0.2	11	7,278	nw.	46	nw.	11	16	6	8	4.4	T.
Philadelphia	117	116	184	29.84	29.97	− .04	54.6	+ 3.8	83	26	65	30	5	45	28	48	43	71	2.35	− 0.6	12	8,836	nw.	38	nw.	19	14	10	6	4.3	T.
Scranton	805	111	119	29.07	29.94	− .07	48.0	+ 0.9	85	23	58	20	5	38	37	42	36	66	2.97	+ 0.3	13	7,368	sw.	44	w.	11	10	9	11	5.4	T.
Atlantic City	52	37	48	29.92	29.98	− .02	50.9	+ 5.3	72	13	58	29	4	44	28	45	39	69	1.47	− 1.5	14	7,520	sw.	41	s.	30	10	10	10	5.3	T.
Cape May	17	48	52	29.98	30.00	+ .01	51.2	+ 2.8	72	13	58	30	5	44	27	46	.....	.....	2.14	− 0.8	14	7,954	s.	46	s.	30	11	11	8	4.7	
Baltimore	123	100	113	29.83	29.96	− .05	56.5	+ 3.5	87	27	67	30	4	46	34	49	43	65	1.09	− 2.2	10	6,135	s.	32	sw.	20	11	7	12	5.2	T.
Washington	112	89	76	29.85	29.97	− .05	56.4	+ 3.3	87	24	68	29	5	45	38	48	41	61	1.60	− 1.6	13	6,663	nw.	43	nw.	30	14	11	5	4.4	T.
Cape Henry	18	9	58	29.96	29.98	− .02	59.0	+ 4.4	86	27	68	34	4	50	30	.....	.....	.....	2.07	− 1.8	11	10,640	sw.	50	ne.	16	17	8	5	4.0	
Lynchburg	681	83	88	29.25	30.00	− .02	58.6	+ 3.0	88	24	70	33	3	47	39	52	47	67	2.96	− 0.2	10	3,712	nw.	27	nw.	11	13	9	8	5.0	
Mount Weather	1,725	10	54	28.12	29.95	− .07	51.8	+ 3.4	80	24	62	24	3	42	31	45	40	71	1.84	− 1.2	12	12,916	nw.	75	nw.	30	10	11	9	5.2	
Norfolk	91	102	111	29.90	30.00	− .01	60.6	+ 4.6	88	24	70	35	4	51	34	54	50	74	3.26	− 0.5	11	7,958	s.	39	sw.	30	12	8	10	5.0	
Richmond	144	145	153	29.86	30.01	− .01	60.0	+ 2.8	90	24	71	31	4	49	34	.....	.....	.....	2.73	− 0.7	12	7,297	s.	40	sw.	20	16	5	9	4.6	
Wytheville	2,293	40	47	27.62	29.99	− .04	54.6	+ 2.6	84	24	66	27	3	43	39	49	45	75	4.89	+ 1.2	12	4,847	w.	27	w.	19	16	6	8	4.1	T.
S. Atlantic States.							66.1	+ 4.8										74	3.06	− 0.4										5.1	
Asheville	2,255	53	75	27.66	29.99	− .04	58.8	+ 4.9	82	10	70	30	3	48	37	53	49	76	3.77	− 0.3	12	6,733	se.	38	e.	16	7	13	10	5.6	
Charlotte	773	68	76	29.18	30.02	− .01	63.4	+ 4.2	84	10	73	38	4	53	31	54	48	64	1.29	− 2.2	9	5,910	sw.	34	sw.	30	8	10	12	6.0	
Hatteras	11	12	47	30.00	30.01	.00	62.6	+ 4.6	77	19	69	43	4	56	19	58	56	82	2.46	− 1.9	12	11,078	sw.	51	ne.	16	18	9	3	3.5	
Manteo	.....	.....	.....	.....	.....	.....	61.2	.....	85	11	70	36	4	52	.....	.....	.....	.....	1.62	− 3.0	7	.....	sw.	.....	.....	.....	21	5	4	.....	
Raleigh	376	71	79	29.60	30.00	− .03	63.2	+ 4.2	87	26	74	35	4	52	32	54	48	63	2.56	− 0.9	8	5,591	sw.	28	nw.	30	9	8	13	5.5	
Wilmington	78	81	91	29.94	30.02	− .01	65.4	+ 5.0	88	11	74	39	4	56	30	59	55	76	2.08	− 0.8	8	7,088	sw.	32	ne.	16	8	15	7	4.9	
Charleston	48	14	92	29.96	30.01	− .02	68.8	+ 5.0	90	11	76	45	17	62	29	63	61	82	4.92	+ 1.9	11	8,684	sw.	47	ne.	16	6	15	9	5.0	
Columbia, S. C.	351	41	57	29.62	30.00	− .03	66.7	+ 3.9	90	10	77	36	4	56	33	59	53	69	3.24	+ 0.4	13	5,567	s.	37	sw.	30	6	14	10	6.0	
Augusta	180	89	97	29.81	30.00	− .03	67.7	+ 4.5	90	10	78	38	4	58	28	61	57	75	5.41	+ 1.9	12	5,330	se.	34	ne.	16	14	11	5	3.9	
Savannah	65	81	89	29.94	30.01	− .02	70.6	+ 5.9	91	10	79	46	17	62	25	63	59	76	3.36	+ 0.4	8	6,335	w.	30	e.	16	8	12	10	5.7	
Jacksonville	43	101	129	29.97	30.02	− .02	73.8	+ 6.2	89	26	82	49	4	66	26	66	64	79	2.93	+ 0.2	11	7,019	sw.	51	sw.	30	8	16	6	5.3	
Florida Peninsula.							77.5	+ 4.7										80	1.04	− 0.7										3.0	
Jupiter	28	10	48	29.99	30.02	− .02	76.4	+ 4.2	90	23	83	65	11	70	22	72	70	82	0.99	− 1.6	5	7,860	se.	36	w.	30	11	17	2	4.5	
Key West	22	10	53	29.99	30.01	− .01	79.8	+ 4.3	89	25	85	70	3	75	15	73	70	77	0.18	− 1.1	2	6,292	e.	35	w.	30	24	6	0	2.4	
Sand Key	25	41	71	29.98	30.01	− .01	78.4	.....	88	23	81	70	28	76	13	.....	.....	.....	0.92	− 0.4	4	8,405	e.	35	w.	30	22	6	2	2.8	
Tampa	35	79	96	29.99	30.03	− .03	76.4	+ 5.8	89	14	85	59	4	68	23	69	67	80	2.07	+ 0.2	7	5,760	w.	34	nw.	28	22	5	3	2.4	
East Gulf States.							68.9	+ 4.3										76	5.20	+ 1.2										5.8	
Atlanta	1,174	190	216	28.78	30.01	− .02	64.0	+ 2.9	85	10	73	37	3	55	31	58	54	77	7.36	+ 3.7	10	9,250	nw.	46	nw.	30	9	10	11	5.6	
Macon	370	55	66	29.61	30.00	− .03	68.1	+ 5.0	90	10	78	40	4	58	29	.....	.....	.....	9.26	+ 5.9	10	3,942	sw.	25	s.	14	9	9	12	5.7	
Thomasville	273	8	58	29.72	30.02	− .01	71.4	+ 4.7	91	9	82	40	4	61	34	64	61	78	4.62	+ 1.0	9	4,123	sw.	27	nw.	27	11	11	8	5.2	
Pensacola	56	79	96	29.95	30.01	− .01	72.2	+ 4.5	87	19	79	52	30	66	23	.....	.....	.....	2.32	− 0.8	10	7,732	s.	42	nw.	27	8	12	10	5.6	
Anniston	741	9	56	29.24	30.03	.00	65.1	+ 4.7	85	26	76	32	4	54	38	.....	.....	.....	3.42	− 0.2	10	4,580	se.	36	s.	24	7	5	18	7.1	
Birmingham	700	11	48	29.26	30.01	− .01	66.0	+ 2.5	84	26	76	40	3	56	28	58	54	72	4.05	+ 0.4	8	5,075	s.	33	s.	29	5	14	11	6.3	
Mobile	57	98	106	29.94	30.00	− .02	71.8	+ 5.8	88	19	79	50	30	64	27	65	62	78	6.42	+ 2.1	13	6,096	s.	33	s.	24	9	15	6	5.2	
Montgomery	223	100	112	29.76	30.01	− .02	68.8	+ 3.6	88	9	79	41	4	59	28	60	56	70	10.96	+ 6.7	13	4,914	sw.	35	sw.	24	4	16	10	6.6	
Meridian	375	84	93	29.59	29.99	− .03	67.6	+ 3.5	87	9	78	42	4	58	30	61	57	74	3.46	− 1.6	12	4,081	sw.	26	w.	29	7	12	11	5.8	
Vicksburg	247	62	74	29.72	30.00	.00	69.2	+ 4.0	86	23	78	45	30	60	33	62	59	76	4.66	− 0.5	12	5,054	s.	31	nw.	26	8	9	13	5.6	
New Orleans	51	88	121	29.94	29.99	− .01	73.8	+ 5.9	89	18	82	51	30	66	25	67	64	79	1.34	− 3.6	5	6,571	se.	30	nw.	30	10	13	7	5.0	
West Gulf States.							67.0	+ 1.5										77	5.00	+ 1.4										5.6	
Shreveport	249	77	84	29.70	29.97	.00	69.0	+ 3.2	87	7	79	42	30	59	29	62	58	74	3.91	− 0.7	12	5,499	se.	36	w.	23	10	10	10	5.5	
Bentonville	1,303	11	44	28.58	29.95	− .01	57.8	+ 0.9	81	22	68	30	30	48	34	.....	.....	.....	8.22	+ 4.3	18	4,623	s.	28	sw.	24	8	11	11	6.5	
Fort Smith	457	79	94	29.46	29.94	− .02	62.0	+ 0.3	84	25	71	36	30	53	35	56	52	76	6.71	+ 2.8	19	5,793	e.	42	sw.	24	8	7	15	6.4	
Little Rock	357	139	147	29.60	29.98	.00	63.8	+ 1.1	84	7	73	37	2	55	31	57	53	73	4.32	− 0.2	13	6,859	s.	49	sw.	24	8	11	11	5.6	T.
Corpus Christi	20	48	53	29.91	29.92	− .03	73.6	+ 2.7	89	24	80	48	30	68	24	68	66	80	4.40	+ 2.6	8	9,229	se.	42	e.	21	7	18	5	4.9	
Fort Worth	670	106	114	29.23	29.94	.00	64.4	− 0.9	87	6	73	38	30	56	32	.....	.....	.....	9.63	+ 7.0	15	7,198	s.	37	nw.	26	10	10	10	5.4	
Galveston	54	106	112	29.92	29.98	+ .01	72.9	+ 4.2	84	24	78	49	30	68	25	69	67	84	1.44	− 1.7	6	9,239	se.	40	nw.	29	8	18	4	4.9	
Palestine	510	73	79	29.42	29.94	− .02	68.0	+ 2.1	86	7	77	42	3	59	29	62	59	80	5.17	+ 1.1	14	3,300	s.	20	sw.	1	5	12	13	6.5	
San Antonio	701	80	91	29.19	29.91	− .02	70.2	+ 1.2	92	25	80	40	30	60	34	63	59	74	2.87	− 0.1	7	5,202	se.	34	s.	11	9	15	6	4.8	
Taylor	583	55	63	29.33	29.94	− .01	68.0	+ 0.5	89	25	78	37	30	58	33	.....	.....	.....	3.36	− 0.6	9	6,957	s.	34	n.	29	9	11	10	5.1	
Ohio Val. and Tenn.							56.7	+ 1.7										67	4.43	+ 0.8										5.8	
Chattanooga	762	106	112	29.21	30.02	− .01	63.8	+ 3.8	84	10	74	34	4	54	31	55	48	63	5.17	+ 0.8	11	4,993	sw.	28	nw.	30	8	9	13	6.0	
Knoxville	1,004	98	100	28.94	30.00	− .03	62.0	+ 4.6	84	26	73	32	4	51	37	53	46	63	3.02	− 1.6	11	4,020	sw.	25	w.	25	6	9	15	6.8	
Memphis	399	76	97	29.58	30.00	.00	64.0	+ 2.2	85	26	73	38	3	55	36	58	55	77	5.75	+ 0.9	13	6,612	sw.	61	w.	26	8	8	14	6.5	
Nashville	546	79	91	29.43	30.02	+ .01	61.2	+ 2.1	84	26	72	33	4	51	33	54	47	65	4.43	+ 0.1	13	4,817	sw.	38	s.	26	7	8	15	6.5	
Lexington	989	75	102	28.93	30.00	− .02	54.7	+ 1.0	81	26	64	26	3	45	33	.....	.....	.....	4.99	+ 1.6	14	8,511	sw.	40	nw.	1	14	8	8	4.6	2.5
Louisville	525	111	132	29.42	30.00	− .01	56.8	+ 0.6	85	26	67	29	3	46	35	50	43	66	6.06	+ 2.0	16	6,767	sw.	36	sw.	8	8	8	14	6.2	0.4
Evansville	431	72	82	29.50	29.97	− .03	57.0	+ 0.6	82	20	66	30	3	48	35	.....	.....	.....	4.83	+ 1.4	16	6,038	s.	42	sw.	8	5	17	8	5.7	
Indianapolis	822	154	164	29.08	29.97	− .03	52.2	− 0.2	76	22	61	25	3	43	32	47	42	71	3.86	+ 0.4	15	8,638	sw.	48	s.	24	10	5	15	6.2	
Cincinnati	628	152	160	29.31	29.99	− .02	55.0	+ 0.7	83	26	65	28	3	45	34	48	41	64	4.07	+ 1.1	14	5,612	sw.	29	w.	27	10	7	13	5.7	1.5
Columbus	824	173	224	29.10	29.98	− .04	51.7	+ 0.7	80	26	62	25	3	42	36	45	39	67	2.75	− 0.1	12	10,099	nw.	44	nw.	2	10	10	10	5.4	2.4
Pittsburg	842	356	352	29.05	29.96	− .06	51.4	+ 0.4	85	24	62	23	3	41	33	44	38	63	3.59	+ 0.7	10	8,576	nw.	49	w.	20	7	11	12	5.8	0.6
Parkersburg	638	77	84	29.33	29.99	− .04	54.7	+ 1.7	86	24	66	27	3	44	41	48	42	66	4.07	+ 1.2	12	5,385	nw.	36	nw.	2	15	7	8	4.8	T.
Elkins	1,940	41	50	27.93	29.99	− .04	52.1	+ 3.4	86	24	64	23	3	40	48	46	41	70	4.95	+ 1.7	13	4,043	w.	28	w.	20	12	10	8	5.3	0.3
Lower Lake Region.							44.4	− 0.3										70	3.11	+ 0.8										6.0	
Buffalo	767	178	206	29.09	29.93	− .08	40.8	− 1.5	73	24	49	21	4	33	35	37	33	75	3.60	+ 1.2	16	12,137	sw.	55	w.	11	7	12	11	6.0	4.6
Canton	448	10	71	29.42	29.91	.....	39.2	− 3.3	79	27	48	12	4	30	36	.....	.....	.....	2.59	+ 0.3	19	11,354	sw.	55	w.	2	7	12	11	6.3	2.1
Oswego	335	76	91	29.54	29.92	− .09	41.7	− 1.5	74	27	50	18	4	33	34	37	32	72	3.90	+ 1.6	18	9,720	s.	40	s.	2	5	11	14	6.1	0.7
Rochester	523	81	102	29.36	29.94	− .07	44.2	+ 0.3	76	27	53	20	4	35	38	37	31	66	2.38	− 0.1	15	8,343	w.	46	w.	11	7	9	14	6.3	6.3
Syracuse	597	97	113	29.28	29.93	− .08	43.0	− 1.4	78	27	52	17	4	34	34	.....	.....	.....	3.33	+ 1.0	19	11,012	nw.	54	w.	11	6	8	16	6.6	4.7
Erie	713	92	102	29.16	29.94	− .08	45.5	+ 0.8	78	24	54	24	4	36	36	39	33	66	3.99	+ 1.6	14	9,387	w.	41	w.	2	9	8	13	5.8	0.3
Cleveland	762	190	201	29.13	29.96	− .06	47.2	+ 1.2	79	24	56	24	3	39	37	42	36	67	3.00	+ 0.7	14	12,425	s.	54	w.	20	9	8	13	5.9	2.4
Sandusky	629	62	70	29.25	29.94	− .08	48.8	+ 1.0	78	24	56	26	3	40	37	.....	.....	.....	2.83	+ 0.3	14	7,546	sw.	34	nw.	11	13	3	14	5.3	0.2
Toledo	628	207	246	29.26	29.95	− .06	48.4	+ 1.1	79	28	57	25	3	40	35	43	38	69	3.07	+ 0.8	14	12,868	sw.	60	sw.	25	10	9	11	5.3	0.1
Detroit	730	218	258	29.15	29.95	− .07	45.4	− 0.1	78	22	55	22	3	36	34	41	37	75	2.44	+ 0.1	13	11,215	sw.	54	w.	11	7	6	17	6.6	0.1
Upper Lake Region.							41.6	+ 1.2										72	2.34	+ 0.6										5.9	
Alpena	609	13	92	29.24	29.91	− .09	39.6	+ 1.6	78	14	49	11	4	31	44	34	29	71	1.77	− 0.4	15	10,077	nw.	48	nw.	11	8	13	9	5.8	3.8

TABLE I.—*Climatological data for U. S. Weather Bureau stations, April, 1908*—Continued.

Stations.	Elevation of instruments: Barometer above sea level, feet.	Elevation of instruments: Thermometers above ground.	Elevation of instruments: Anemometer above ground.	Pressure, in inches: Actual, reduced to mean of 24 hours.	Pressure, in inches: Sea level, reduced to mean of 24 hrs.	Pressure, in inches: Departure from normal.	Temperature: Mean max. + mean min. ÷ 2.	Temperature: Departure from normal.	Temperature: Maximum.	Temperature: Date.	Temperature: Mean maximum.	Temperature: Minimum.	Temperature: Date.	Temperature: Mean minimum.	Temperature: Greatest daily range.	Mean wet thermometer.	Mean temperature of the dew-point.	Mean relative humidity, per cent.	Precipitation: Total.	Precipitation: Departure from normal.	Precipitation: Days with .01, or more.	Wind: Total movement, miles.	Wind: Prevailing direction.	Wind: Maximum velocity: Miles per hour.	Wind: Maximum velocity: Direction.	Wind: Maximum velocity: Date.	Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness during daylight, tenths.	Total snowfall.
Up. Lake Reg—Cont.																															
Escanaba	612	40	82	29.24	29.92	-.10	38.7	+1.5	73	22	47	15	3	30	41	34	29	74	2.98	+0.9	13	8,379	s.	56	e.	27	6	12	12	6.3	4.5
Grand Haven	632	54	92	29.23	29.92	-.09	43.4	-0.7	74	24	52	21	2	35	30	39	34	74	4.14	+1.7	14	10,956	w.	44	w.	2	10	12	8	5.5	0.1
Grand Rapids	707	121	162	29.16	29.93	-.09	45.2	-1.0	79	23	55	21	2	35	35	40	35	70	4.87	+2.4	14	10,863	sw.	48	sw.	12	7	11	12	6.2	0.1
Houghton	668	66	74	29.15	29.89	-.13	37.9	+1.0	81	14	46	9	3	29	39	....	....	....	2.94	+0.9	16	6,406	e.	32	nw.	10	9	12	9	5.6	8.5
Marquette	734	77	116	29.10	29.91	-.11	38.5	+1.0	79	14	46	12	3	31	39	33	27	67	3.13	+1.1	17	8,558	nw.	48	sw.	14	6	14	10	5.8	9.5
Port Huron	638	70	120	29.23	29.93	-.09	43.2	+1.0	79	22	52	21	4	34	37	39	34	71	1.79	-0.3	14	10,133	sw.	49	sw.	27	7	6	17	6.9	T.
Sault Sainte Marie	614	40	61	29.21	29.92	-.11	35.4	-0.3	66	14	44	5	4	27	35	31	27	77	2.31	+0.2	16	7,978	nw.	47	w.	11	8	7	15	6.7	3.6
Chicago	823	140	310	29.04	29.94	-.06	49.0	+3.1	76	22	57	24	2	41	29	43	39	74	2.81	-0.1	14	12,454	sw.	52	w.	25	8	8	14	5.6	T.
Milwaukee	681	122	139	29.20	29.94	-.05	45.2	+3.4	80	22	53	21	2	37	34	40	35	75	3.61	+0.9	11	9,585	w.	44	ne.	15	14	8	8	4.4	
Green Bay	617	49	86	29.21	29.88	-.13	43.8	+3.1	83	22	53	18	2	34	34	38	32	68	2.84	+0.4	13	9,973	sw.	52	ne.	15	7	11	12	6.1	4.7
Duluth	1,133	11	47	28.65	29.89	-.12	38.8	+0.4	82	14	48	10	2	29	47	33	26	67	2.07	-0.1	8	11,708	ne.	55	nw.	10	9	13	8	5.8	7.0
North Dakota.							43.8	+3.2										66	1.37	-0.5										5.0	
Moorhead	940	8	57	28.88	29.90	-.09	44.8	+3.4	90	21	58	6	2	32	50	38	33	72	1.20	-1.1	5	8,523	nw.	36	nw.	1	13	5	12	5.1	6.0
Bismarck	1,674	8	57	28.14	29.94	-.03	45.4	+2.8	89	13	60	0	2	31	49	38	30	63	1.73	-0.2	11	10,588	nw.	49	nw.	25	11	11	8	5.2	4.8
Devils Lake	1,482	11	44	28.29	29.89	-.10	41.4	+3.2	85	21	55	-4	2	28	43	35	29	67	0.60	-1.4	5	11,078	nw.	47	nw.	9	14	8	8	4.6	7.0
Williston	1,875	14	56	27.92	29.92	-.04	43.8	+3.3	90	20	57	-4	1	31	43	36	28	62	1.96	+0.7	5	10,216	nw.	50	w.	25	12	10	8	5.1	4.3
Upper Miss. Valley.							51.3	+0.8										67	3.50	+0.5										5.2	
Minneapolis	....	102	208	....	....	....	46.7	....	81	14	57	16	2	37	37	....	....	....	4.07	+1.6	10	11,014	se.	48	w.	1	13	6	11	4.6	11.7
St. Paul	837	171	179	28.98	29.89	-.10	47.4	+1.7	80	14	57	16	2	37	37	40	32	61	4.23	+1.9	9	9,599	nw.	44	nw.	1	15	8	7	4.1	12.0
La Crosse	714	10	49	29.13	29.90	-.08	48.0	+0.7	83	22	59	18	2	38	39	....	....	....	2.99	+0.7	13	5,468	se.	24	sw.	12	10	9	11	5.3	T.
Madison	974	70	78	28.86	29.92	-.07	46.0	+1.5	78	22	56	18	2	36	34	40	34	69	4.41	+2.0	11	9,226	sw.	48	n.	15	10	11	9	5.0	T.
Charles City	1,015	3	49	28.84	29.92	-.06	47.4	+1.1	79	19	59	16	2	36	37	42	37	72	2.00	-0.8	7	6,848	nw.	32	sw.	12	10	11	9	5.4	T.
Davenport	606	71	79	29.27	29.94	-.04	50.4	+0.2	78	19	60	20	2	40	32	44	38	67	2.22	-0.7	9	6,985	nw.	30	w.	25	11	10	9	5.1	
Des Moines	861	84	101	29.01	29.92	-.05	51.8	+1.2	84	19	63	18	2	41	37	45	38	65	2.69	-0.3	8	7,388	nw.	33	sw.	12	9	14	7	5.3	T.
Dubuque	698	100	117	29.19	29.95	-.03	48.8	-0.1	79	14	59	19	2	39	35	42	36	65	2.50	-0.4	12	5,846	nw.	30	nw.	1	12	9	9	4.5	0.1
Keokuk	614	64	77	29.28	29.95	-.03	53.7	+1.7	80	19	64	24	2	43	34	46	40	68	1.82	-1.5	9	6,629	nw.	35	sw.	24	12	12	6	4.2	T.
Cairo	356	87	93	29.61	30.00	+.01	59.2	+0.9	81	22	68	33	3	50	35	52	47	70	6.63	+3.1	15	7,314	s.	36	sw.	26	5	12	13	6.6	
La Salle	536	56	64	29.38	29.96	-.03	50.7	+0.9	79	22	61	24	2	40	34	....	....	....	2.89	-0.2	12	7,919	w.	36	s.	25	10	7	13	5.5	T.
Peoria	609	11	45	29.29	29.96	-.03	51.0	+0.1	79	22	62	22	3	40	35	45	39	69	4.08	+0.8	14	7,946	nw.	44	s.	24	12	10	8	4.2	T.
Springfield, Ill	644	10	92	29.27	29.95	-.03	53.1	+1.1	79	23	63	26	3	43	32	46	40	66	4.48	+1.2	14	7,572	sw.	37	s.	24	13	1	16	5.8	T.
Hannibal	584	75	109	29.37	29.94	-.04	54.0	+0.4	79	20	64	24	3	44	40	....	....	....	3.64	+0.4	14	7,828	sw.	46	sw.	24	11	3	16	6.0	
St. Louis	567	208	217	29.34	29.95	-.03	56.1	0.0	82	23	65	29	2	47	31	49	42	65	3.84	+0.3	16	7,940	se.	42	w.	24	9	6	15	6.1	
Missouri Valley.							52.9	+2.4										62	2.68	-0.2										5.1	
Columbia, Mo	784	11	84	29.13	29.96	-.02	54.9	+0.6	83	20	66	24	3	44	38				4.26	+0.6	11	6,197	nw.	35	s.	23	8	7	15	6.0	
Kansas City	963	116	181	28.92	29.96	.00	55.9	+1.6	82	20	65	24	2	47	36	48	42	66	2.13	-1.2	11	10,384	s.	44	n.	1	10	12	8	5.4	
Springfield, Mo	1,324	98	104	28.56	29.96	-.01	55.4	-0.3	82	22	64	28	2	46	36	50	47	78	7.75	+3.9	13	7,734	se.	40	e.	23	9	8	13	5.9	
Iola	984	11	50	28.92	29.97	+.02	56.3	+2.1	81	22	66	27	2	46	35	....	....	....	5.95	+3.2	10	6,249	s.	35	nw.	24	0	18	12	7.4	
Topeka	....	85	89	....	....	....	55.9	+2.2	83	20	67	22	2	45	38	....	....	....	2.05	-0.7	9	7,361	s.	38	nw.	1	12	12	6	4.8	
Lincoln	1,189	11	84	28.66	29.93	-.01	54.2	+3.5	85	19	67	17	2	42	38	44	36	58	1.28	-1.5	9	9,767	s.	48	nw.	24	12	13	5	4.4	T.
Omaha	1,105	115	121	28.75	29.94	-.01	53.4	+2.9	86	19	64	16	2	42	39	45	36	59	1.09	-1.9	5	8,080	nw.	37	n.	1	9	10	11	5.7	T.
Valentine	2,598	47	54	27.22	29.95	+.01	48.4	+3.0	89	13	63	6	2	34	47	38	28	58	0.96	-1.4	6	10,141	nw.	51	nw.	26	16	10	4	3.6	2.9
Sioux City	1,135	96	164	28.72	29.94	-.01	51.0	+2.5	86	19	62	14	2	40	40	....	....	....	1.64	-1.1	5	12,451	nw.	50	nw.	25	15	5	10	4.3	0.5
Pierre	1,572	70	75	28.26	29.93	-.02	50.8	+4.3	90	13	64	12	1	38	47	40	29	51	1.41	-0.6	5	9,922	nw.	51	nw.	14	16	5	9	4.4	3.2
Huron	1,306	56	67	28.53	29.94	-.02	47.4	+2.8	90	13	61	11	2	34	49	39	31	62	1.45	-1.2	5	10,875	nw.	46	nw.	24	15	5	10	4.4	3.9
Yankton	1,233	49	57	28.61	29.93	-.02	51.0	+3.6	88	13	63	14	2	39	43	....	....	....	2.14	-0.7	5	8,725	nw.	35	nw.	1	16	3	11	4.8	T.
Northern Slope.							46.0	+3.3										58	0.73	-0.8										4.2	
Havre	2,505	11	44	27.29	29.93	.00	47.1	+4.4	84	20	60	-4	1	34	40	40	32	62	0.28	-0.7	5	8,380	nw.	36	nw.	4	14	4	2	3.8	0.1
Miles City	2,371	26	48	27.42	29.98	+.02	48.9	+4.2	91	20	63	2	1	35	46	40	33	62	0.91	-0.3	6	5,987	s.	36	w.	24	12	15	3	3.9	1.5
Helena	4,110	8	56	25.78	29.99	+.02	46.9	+4.9	82	19	59	10	1	35	41	37	26	50	0.52	-0.6	6	6,173	w.	38	sw.	25	13	6	11	5.3	2.5
Kalispell	2,962	8	34	26.92	29.99	+.03	45.4	+2.9	74	19	58	22	7	33	44	37	29	61	0.71	-0.4	8	4,564	sw.	29	w.	24	11	14	5	4.9	0.9
Rapid City	3,234	46	50																												
Cheyenne	6,088	56	64	23.95	29.93	+.02	44.2	+2.6	75	13	58	7	2	30	43	34	21	46	0.36	-1.5	6	8,544	nw.	50	nw.	24	9	16	5	4.5	2.6
Lander	5,372	26	36	24.60	29.96	+.02	45.5	+3.3	77	20	61	8	1	30	45	36	27	56	1.57	-0.9	5	3,313	sw.	42	s.	22	16	6	8	3.9	13.4
Sheridan	3,790	9	47	26.05	29.96	....	46.2	....	84	20	61	3	1	31	53	37	27	56	1.06	....	6	6,686	nw.	50	nw.	24	14	10	6	4.2	1.7
Yellowstone Park	6,200	11	48	23.84	30.00	+.04	39.4	+2.7	71	19	52	2	2	27	44	32	24	59	0.88	-0.5	9	5,930	sw.	34	sw.	15	9	12	9	4.8	6.9
North Platte	2,821	11	51	27.03	29.96	+.04	50.7	+1.7	86	14	66	14	1	35	51	41	32	60	0.64	-1.5	4	7,789	n.	47	nw.	24	17	5	8	4.0	T.
Middle Slope.							54.6	+0.9										59	1.86	-0.4										5.2	
Denver	5,291	129	136	24.67	29.92	+.02	50.4	+2.7	78	14	64	21	2	37	42	38	26	46	0.39	-1.8	6	5,789	s.	40	n.	25	13	16	1	4.0	3.5
Leadville	10,248	7	....	....	....	....	32.7	....	57	13	44	4	26	21	33	....	....	....	1.41	....	10	....	nw.	....	....	....	....	....	....	....	16.9
Pueblo	4,685	80	86	25.23	29.91	+.03	51.6	+1.1	81	14	66	20	3	37	47	39	24	40	0.05	-1.4	4	5,962	se.	40	nw.	23	14	15	1	3.5	T.
Concordia	1,398	42	50	28.48	29.96	+.03	55.2	+1.6	85	19	67	20	2	43	44	46	39	63	0.86	-1.6	8	6,336	s.	32	nw.	24	4	18	8	6.1	
Dodge	2,509	44	54	27.34	29.94	+.04	55.0	+0.6	87	22	68	20	2	43	45	41	29	62	1.35	-0.5	8	8,076	se.	48	w.	24	11	15	4	4.6	
Wichita	1,358	90	120	28.54	29.97	+.04	56.6	0.0	85	6	67	26	2	46	35	50	44	68	1.77	-0.9	8	9,141	s.	46	nw.	24	1	18	11	6.5	
Oklahoma	1,214	10	47	28.66	29.94	+.02	59.1	-0.5	84	6	69	34	3	50	34	53	49	76	6.73	+3.9	17	11,408	s.	59	nw.	24	5	15	10	6.3	T.
Southern Slope.							61.6	-0.8										63	3.16	+1.3										5.1	
Abilene	1,738	45	54	28.14	29.94	+.04	62.6	-1.8	86	6	72	36	2	53	32	55	50	71	6.72	+4.4	13	6,430	s.	29	e.	18	7	9	14	6.3	
Amarillo	3,676	10	49	26.21	29.91	+.04	55.8	+1.2	80	14	69	29	2	43	38	46	38	63	1.90	+0.2	5	9,093	s.	60	n.	25	20	9	1	3.5	
Del Rio	944	8	57	28.92	29.90	+.01	69.0	-1.0	94	7	80	38	30	58	43	....	....	....	2.82	-0.1	12	5,924	se.	44	nw.	29	11	6	13	5.6	
Roswell	3,578	9	57	26.31	29.91	+.06	58.9	-1.7	87	14	74	34	30	44	48	47	38	56	1.29	+0.8	7	5,070	s.	40	ne.	28	10	11	9	5.1	
Southern Plateau.							58.0	+0.1										42	0.96	+0.2										3.7	
El Paso	3,762	110	133	26.14	29.86	+.03	62.4	-1.4	84	28	75	43	3	50	36	47	30	38	0.88	+0.6	7	9,452	w.	54	ne.	26	14	11	5	3.8	
Santa Fe	7,013	33	39	23.19	29.87	+.03	46.6	-1.0	68	30	59	24	26	34	37	38	29	57	1.85	+1.0	10	7,413	n.	38	w.	28	14	13	3	3.7	5.9
Flagstaff	6,907	8	57	23.31	29.88	+.04	42.8	+0.6	72	30	58	16	2	27	47	34	26	61	1.10	-0.5	6	6,195	sw.	37	sw.	7	17	8	5	3.4	4.5
Phoenix	1,108	50	56	28.72	29.87	.00	67.6	+1.0	92	28	83	44	9	52	39	50	30	30	0.90	+0.5	1	3,409	e.	21	w.	21	23	6	1	1.8	
Yuma	141	9	58	29.72	29.87	-.02	71.1	+1.0	99	28	88	41	3	54	47	53	36	35	0.05	0.0	1	5,328	sw.	30	w.	7	29	0	1	0.7	
Independence	3,910	11	42	25.95	29.92	+.02	57.2	+0.5	82	19	73	31	3	42	30	43	25	33	T.	-0.7	0	6,612	nw.	36	n.	7	20	6	4	2.9	
Middle Plateau.							49.5	+1.8										40	0.70	-0.5										3.3	
Reno	4,532	56	63	25.48	30.00	+.03	49.4	+2.1	78	11	65	19	1	34	45	38	27	50	0.11	-0.5	3	4,932	w.	25	w.	22	19	6	5	3.1	T.
Tonopah	6,089	12	20	24.05	29.99	......	49.2	+5.7	71	12	61	18	1	38	33	36	19	34	0.38	-1.3	1	7,131	nw.	40	nw.	6	20	9	1	2.4	2.0
Winnemucca	4,344	18	56	25.62	30.02	+.06	48.1	+1.0	81	19	65	12	1	31	48	38	27	52	0.87	0.0	3	4,738	sw.	29	sw.	23	19	8	3	2.7	
Modena	5,479	10	43	24.58	29.92	+.04	47.2	+0.3	75	30	63	18	2	31	46	39	32	60	0.76	-0.9	3	9,044	w.	50	sw.	6	15	8	7	4.1	1.6
Salt Lake City	4,366	105	110	25.58	29.94	+.02	52.4	+2.3	78	12	64	25	1	41	34	41	28	41	0.80	-1.5	5	5,798	nw.	38	n.	27	23	3	4	2.6	1.0
Durango	6,546	18	56	23.60	29.89	+.04	46.5	+0.1	73	30	61	22	26	32	44	36	25	51	1.90	+0.8	13	5,142	nw.	32	w.	28	10	17	3	4.5	0.5
Grand Junction	4,608	43	51	25.33	29.90	+.02	54.0	+0.8	80	14	67	27	2	40	38	40	25	37	0.48	-0.2	5	4,632	nw.	40	sw.	22	16	9	5	3.7	T.
Northern Plateau.							50.8	+1.8										50	0.60	-0.8										3.9	
Baker City	3,471	48	58	26.46	30.02	+.06	46.8	+3.3	78	19	60	23	7	34	39	40	33	61	0.93	0.0	5	5,388	nw.	29	n.	3	13	11	6	4.3	2.5
Boise	2,739	78	86	27.18	30.04	+.06	51.8	+1.7	84	19	64	26	1	39	37	41	28	45	0.28	-0.9	5	4,964	nw.	33	se.	19	16	4	10	4.3	T.
Lewiston	757	10	51	29.25	30.07	+.08	53.2	+0.3	87	19	66	27	7	41	40	....	....	....	0.96	-0.2	11	4,698	e.	56	w.	24	9	12	9	5.0	T.
Pocatello	4,477	46	54	25.46	29.98	+.04	50.0	+3.2	78	12	63	23	2	37	38	38	24	43	0.53	-1.5	6	6,853	se.	37	sw.	27	20	9	1	2.5	0.4
Spokane	1,929	101	110	27.98	30.05	+.06	48.8	+1.1	81	19	60	23	7	37	37	40	30	55	0.54	-0.8	7	5,629	s.	39	sw.	24	17	11	2	3.5	T.
Walla Walla	1,000	71	79	28.99	30.07	+.06	54.2	+1.4	80	30	65	31	7	43	36	44	32	48	0.38	-1.3	8	4,877	s.	35	sw.	16	15	10	5	3.9	
N. Pac. Coast Reg.							48.4	0.0										77	2.90	-0.4										5.8	
Blaine	57	4	....	....	....	....	47.4	....	79	30	56	29	14	39	32	....	....	....	1.54	....	14	....	....	....	....	....	....	....	....	....	....
North Head	211	11	56	29.90	30.14	+.09	47.2	-0.3	72	29	51	38	6	43	22	45	42	85	3.34	+0.1	17	12,252	nw.	85	se.	16	8	11	11	6.2	
Port Crescent	259	12	29	29.83	30.12	+.10	43.0	-1.7	65	30	51	28	14	35	28	....	....	....	3.47	+1.0	14	3,974	w.	16	sw.	24	3	14	13	6.7	T.
Seattle	123	185	224	30.00	30.14	+.11	49.0	-0.4	79	30	57	35	7	42	31	46	44	84	2.19	-0.5	10	6,733	s.	42	s.	24	6	14	10	5.9	
Tacoma	213	113	120	29.87	30.11	+.08	49.0	+0.1	82	30	58	32	7	40	35	44	39	72	3.00	+0.2	13	4,861	sw.	31	sw.	24	14	10	6	4.1	T.

TABLE I.—*Climatological data for U. S. Weather Bureau stations, April, 1908*—Continued.

Stations.	Elevation of instruments.			Pressure, in inches.			Temperature of the air, in degrees Fahrenheit.										Mean wet thermometer.	Mean temperature of the dew-point.	Mean relative humidity, per cent.	Precipitation, in inches.			Wind.										
	Barometer above sea level, feet.	Thermometers above ground.	Anemometer above ground.	Actual, reduced to mean of 24 hours.	Sea level, reduced to mean of 24 hrs.	Departure from normal.	Mean max. + mean min. ÷ 2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.				Total.	Departure from normal.	Days with .01, or more.	Total movement, miles.	Prevailing direction.	Maximum velocity. Miles per hour.	Direction.	Date.	Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness during daylight, tenths.	Total snowfall.
N. P. Coast Reg—Cont.																															
Tatoosh Island	86	7	57	30.00	30.10	+ .10	46.2	+ 0.1	66	30	51	36	5	42	20	43	40	79	4.49	− 1.8	17	11,631	sw.	60	s.	17	2	8	20	7.9	
Portland, Oreg	153	68	106	29.96	30.11	+ .05	52.8	+ 1.6	82	30	62	34	7	43	33	46	40	66	3.38	+ 0.3	13	5,054	nw.	27	sw.	23	11	11	8	4.8	
Roseburg	510	9	57	29.56	30.12	+ .05	51.8	+ 0.9	85	29	65	27	4	38	48	47	43	76	0.44	− 2.0	8	2,853	nw.	20	sw.	19	15	6	9	4.7	
Mid. Pac. Coast Reg.							57.4	+ 2.0										64	0.31	− 1.9										3.5	
Eureka	62	62	80	30.06	30.12	+ .01	49.7	+ 0.2	65	18	55	35	1	45	19	47	44	83	0.85	− 3.1	7	7,185	n.	46	n.	27	17	6	7	4.2	
Mount Tamalpais	2,375	11	18	27.56	30.03	− .02	53.8		81	11	61	36	22	47	24	45	37	60	0.59	− 1.4	6	12,357	n.	58	nw.	6	20	5	5	2.9	
Point Reyes Light	490	7	18	29.48	30.00		51.5		71	28	56	43	6	47	24				0.18		5	15,112	nw.	80	nw.	6	15	5	10	4.3	
Red Bluff	332	50	56	29.63	29.99	− .04	63.0	+ 3.9	91	10	75	40	5	51	37	51	39	50	0.12	− 1.7	3	5,610	nw.	35	n.	7	17	4	9	3.8	
Sacramento	69	106	117	29.93	30.00	− .01	61.0	+ 3.0	87	11	73	42	6	49	34	52	44	59	0.08	− 1.9	3	7,233	s.	36	nw.	7	22	6	2	2.1	
San Francisco	155	200	204	29.87	30.04	− .01	56.4	+ 2.7	85	28	64	45	4	49	28	49	43	69	0.22	− 1.6	4	5,864	w.	29	sw.	11	17	10	3	3.4	
San Jose	141	78	88	29.88	30.03		57.1	+ 0.4	88	11	71	33	1	43	43				0.23	− 1.6	4	4,754	nw.	30	nw.	6	20	7	3	2.7	
Southeast Farallon	30	9	17	30.01	30.04		51.0		59	17	54	44	7	49	9				0.10	− 1.8	2	12,154	nw.	59	nw.	6	16	5	9	4.6	
S. Pac. Coast Reg.							60.3	+ 2.5										65	0.45	− 0.6										2.5	
Fresno	330	67	70	29.63	29.98	− .01	64.1	+ 2.9	96	12	79	34	1	49	38	51	38	46	0.80	+ 0.1	2	4,148	w.	24	nw.	7	24	4	2	1.7	
Los Angeles	338	116	123	29.62	29.98	− .01	61.2	+ 3.6	90	26	72	44	5	51	32	53	48	71	0.52	− 0.6	1	3,937	w.	28	sw.	8	19	6	5	3.2	
San Diego	87	94	102	29.89	29.98	− .01	59.4	+ 1.2	83	26	65	46	2	54	24	54	50	74	0.35	− 0.4	1	4,258	w.	19	nw.	27	28	1	1	1.9	
San Luis Obispo	201	47	54	29.82	30.03	− .02	57.6	+ 2.4	89	27	70	34	7	45	43	50	44	69	0.14	− 1.3	4	3,933	n.	20	ne.	18	19	4	7	3.2	
West Indies.																															
Grand Turk	11	6	20	30.04	30.05	+ .04	79.4		88	30	85	68	3	74					0.27		6										
San Juan	82	48	90	29.93	30.01	+ .03	77.0		86	22	82	70	3	72	15	71	68	74	3.56	0.0	16	8,917	e.	30	e.	6	22	7	1	2.5	
Panama.																															
Christobal	74			29.85	29.87		80.1		87	25	83	74	27	77	11	75	73	81	1.27		18	10,156	n.	32	ne.	8	7	21	2	4.7	
Bas Obispo	40			29.69	29.86		80.3		92	20	89	65	2	71	26	73	71	81	1.81		10	4,244	nw.	20	nw.	5	0	14	16	7.3	
Ancon				29.77	29.85		82.8		95	18	92	71	20	74	23	73	71	75	1.37		4	6,242	nw.	26	n.	6	5	18	7	5.5	
Alhajuela							78.8		95	25	88	60	16	70	26				4.61		8	3,807	ne.	25	ne.	7					
Bohio							79.8		92	25	88	65	2	71	26				2.16		12	2,686	nw.	18	nw.	1					
Gatun							81.0		92	25	88	68	2	74	20				1.47		20	7,165	n.	28	n.	8					

TABLE II.—*Accumulated amounts of precipitation for each 5 minutes, for storms in which the rate of fall equaled or exceeded 0.25 in any 5 minutes, or 0.80 inch in 1 hour, during April, 1908, at all stations furnished with self-registering gages.*

Stations.	Date.	Total duration. From—	Total duration. To—	Total amount of precipitation.	Excessive rate. Began—	Excessive rate. Ended—	Amount before excessive began.	5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
Abilene, Tex	17–18	8:30 p. m.	7:05 a. m.	2.31	10:00 p. m.	10:25 p. m.	0.04	0.23	0.46	0.55	0.59										
					1:05 a. m.	1:40 a. m.	0.81	0.06	0.27	0.35	0.36	0.41	0.51	0.57							
Albany, N. Y	27–28			0.72														0.30			
Alpena, Mich	27–28			0.37														0.13			
Amarillo, Tex	15–16	10:20 p. m.	2:15 a. m.	0.66	10:25 p. m.	10:38 p. m.	0.02	0.10	0.32	0.46											
Anniston, Ala	14–15			2.14														0.42			
Asheville, N. C	24–25			2.07														0.65			
Atlanta, Ga	24–25	6:45 p. m.	3:35 p. m.	3.66	11:14 p. m.	11:58 p. m.	0.33	0.25	0.34	0.91	1.16	1.40†	1.64†	1.88†	2.12†	2.35†					
Atlantic City, N. J	2			0.20														0.18			
Augusta, Ga	26–27	4:45 p. m.	9:45 a. m.	2.01	7:54 p. m.	8:25 p. m.	0.18	0.13	0.16	0.17	0.31	0.48	0.59	0.63							
Baltimore, Md	8			0.28														0.16			
Bentonville, Ark	23	8:45 a. m.	4:55 p. m.	2.38	1:11 p. m.	1:51 p. m.	0.21	0.08	0.14	0.40	1.04	1.59	1.76	1.81	1.88						
Binghamton, N. Y	8			0.65														0.41			
Birmingham, Ala	24	1:40 p. m.	6:42 p. m.	1.74	4:35 p. m.	5:12 p. m.	0.14	0.10	0.30	0.52	0.85	1.00	1.04	1.20	1.24						
Bismarck, N. Dak	23–24			1.01														*			
Block Island, R. I	2			0.44														0.21			
Boise, Idaho	21–22			0.10						0.07											
Boston, Mass	8–9			0.39														0.20			
Buffalo, N. Y	1–2			0.30														0.14			
Cairo, Ill	9–10			2.01														0.61			
Canton, N. Y	27–28			0.57														0.27			
Charles City, Iowa	7			0.91														*			
Charleston, S. C	30	8:03 a. m.	11:20 a. m.	0.76	8:56 a. m.	9:07 a. m.	0.03	0.35	0.61	0.65											
Charlotte, N. C	25			0.51														0.34			
Chattanooga, Tenn	24	1:58 p. m.	9:10 p. m.	1.82	5:39 p. m.	6:39 p. m.	0.05	0.05	0.10	0.17	0.28	0.38	0.55	0.81	1.09	1.14	1.32	1.45			
Cheyenne, Wyo	30			0.16														*			
Chicago, Ill	6–7			0.80														0.33			
Cincinnati, Ohio	7–8			0.96														0.35			
Cleveland, Ohio	8			0.58														0.24			
Columbia, Mo	14–15			1.43														0.48			
Columbia, S. C	26			0.60						0.42											
Columbus, Ohio	15			0.48														0.19			
Concord, N. H	30			0.27														0.20			
Corpus Christi, Tex	20–21	10:10 p. m.	2:15 a. m.	1.66	12:08 a. m.	1:08 a. m.	0.12	0.10	0.18	0.31	0.51	0.71	0.95	1.13	1.18	1.23	1.28	1.36			
Davenport, Iowa	23–24			0.73														0.33			
Del Rio, Tex	11–12			2.03														0.38			
Denver, Colo	28			0.16														*			
Des Moines, Iowa	22–23	11:30 p. m.	6:05 a. m.	1.18	12:01 a. m.	12:11 a. m.	0.06	0.19	0.42												
Detroit, Mich	26			0.39									0.30								
Dodge, Kans	20–21			0.94														*			
Dubuque, Iowa	23–24			0.99														0.64			
Duluth, Minn	24–25			1.21														0.16			
Eastport, Me	8–9			1.23														0.11			
Elkins, W. Va	15–16	7:05 p. m.	8:10 a. m.	0.80	7:59 p. m.	8:19 p. m.	0.08	0.21	0.36	0.47	0.54										
Erie, Pa	18			0.82														0.22			
Escanaba, Mich	27			1.33														0.43			
Evansville, Ind	24			0.91														0.37			
Fort Smith, Ark	23–24			0.51					0.35												
Fort Worth, Tex	23			1.84												1.84*					
Galveston, Tex	29			0.36					0.30												
Grand Haven, Mich	23–24			1.16														0.43			
Grand Rapids, Mich	23–24			1.77														0.67			
Green Bay, Wis	26–27			1.13														*			
Hannibal, Mo	6			0.47														0.39			

TABLE II.—*Accumulated amounts of precipitation for each 5 minutes, etc.*—Continued.

Stations.	Date.	Total duration. From—	Total duration. To—	Total amount of precipitation.	Excessive rate. Began—	Excessive rate. Ended—	Amount before excessive began.	Depths of precipitation (in inches) during periods of time indicated. 5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
Harrisburg, Pa	27			0.43					0.41												
Hartford, Conn	8-9			1.06														0.46			
Hatteras, N. C	28			0.64					0.35												
Huron, S. Dak	23			0.56														0.16			
Indianapolis, Ind	26	4:03 p. m.	5:31 p. m.	0.61	4:11 p. m.	4:39 p. m.	0.03	0.09	0.12	0.26	0.32	0.45	0.55								
Iola, Kans	6	4:15 p. m.	5:30 p. m.	1.86	4:24 p. m.	5:12 p. m.	0.02	0.07	0.18	0.24	0.54	0.95	1.18	1.43	1.52	1.64	1.72				
Do	6-7	11:15 p. m.	7:15 a. m.	1.87	1:57 a. m.	3:21 a. m.	0.28	0.12	0.21	0.29	0.46	0.67	0.79	0.83	0.83	0.83	0.83	0.90	1.28	1.37	
Jacksonville, Fla	30			0.94					0.46												
Jupiter, Fla	22			0.60														0.41			
Kansas City, Mo	22			0.80														0.26			
Keokuk, Iowa	22-23			0.56														0.24			
Key West, Fla	30			0.06					0.06												
Knoxville, Tenn	24-25			1.45														0.49			
La Crosse, Wis	24			1.02														0.58			
La Salle, Ill	23-24			1.09														0.35			
Lexington, Ky	24			0.76														0.23			
Lincoln, Nebr	22			0.52														0.50			
Little Rock, Ark	17-18			0.34				0.25													
Los Angeles, Cal	22			0.52														0.22			
Louisville, Ky	14-15			1.52														0.41			
Lynchburg, Va	8			0.30					0.30												
Macon, Ga	26-27	4:23 p. m.	8:50 a. m.	3.55	5:35 p. m.	6:30 p. m.	0.27	0.17	0.33	0.52	0.67	0.86	0.93	1.00	1.05	1.16	1.29	1.34			
Madison, Wis	23-24			1.93														0.40			
Marquette, Mich	26-27			0.94														*			
Memphis, Tenn	17-18	11:15 p. m.	8:10 a. m.	1.88	5:13 a. m.	5:46 a. m.	0.81	0.16	0.28	0.35	0.37	0.51	0.54	0.68							
Meridian, Miss	24	10:44 a. m.	3:45 p. m.	0.85	12:45 p. m.	1:14 p. m.	0.03	0.05	0.21	0.49	0.66										
Milwaukee, Wis	26-27			0.84														0.37			
Minneapolis, Minn	24-25			1.52														0.36			
Mobile, Ala	29	9:55 p. m.	D. N.	2.58	10:08 p. m.	10:40 p. m.	0.04	0.13	0.43	0.77	1.29	1.92	2.31	2.36							
Montgomery, Ala	24-25	4:18 p. m.	D. N.	3.95	7:20 p. m.	8:10 p. m.	0.01	0.20	0.30	0.33	0.39	0.47	0.51	0.75	0.84	0.85	0.85				
					8:10 p. m.	9:00 p. m.		0.85	0.86	0.97	1.17	1.21	1.22	1.23	1.24	1.27	1.32				
					9:00 p. m.	9:50 p. m.		1.38	1.51	1.58	1.61	1.71	1.92	2.11	2.61	3.09	3.13				
					9:50 p. m.	10:40 p. m.		3.14	3.14	3.15	3.17	3.24	3.29	3.31	3.46	3.54	3.57				
					10:40 p. m.	11:02 p. m.		3.61	3.67	3.74	3.82	3.84									
Do	26-27	1:45 p. m.	D. N.	3.84	3:36 p. m.	5:33 p. m.	0.34	0.08	0.16	0.48	0.79	0.99	1.24	1.41	1.50	1.56	1.65	1.86	2.20	2.76	3.04
Mount Weather, Va	15-16			0.40														*			
Nantucket, Mass	30			0.82														0.42			
Nashville, Tenn	24			1.28														0.50			
New Haven, Conn	30			0.66														0.27			
New Orleans, La	6	5:50 p. m.	6:30 p. m.	0.64	6:03 p. m.	6:22 p. m.	0.01	0.12	0.33	0.50	0.61										
New York, N. Y	30			0.78														0.42			
Norfolk, Va	11	12:30 a. m.	1:30 a. m.	1.18	12:47 a. m.	1:25 a. m.	0.03	0.10	0.21	0.36	0.57	0.60	0.70	1.04	1.15						
Northfield, Vt	28			0.58														0.37			
North Head, Wash	16-17			1.08														0.15			
Oklahoma, Okla	17			1.40					0.31												
Omaha, Nebr	23	7:25 p. m.	8:05 p. m.	0.55	7:30 p. m.	7:58 p. m.	0.01	0.05	0.19	0.39	0.44	0.50	0.53								
Palestine, Tex	14	7:01 a. m.	8:15 a. m.	0.97	7:01 a. m.	7:47 a. m.	0.00	0.09	0.19	0.27	0.30	5.35	0.53	0.58	0.66	0.85	0.89				
Parkersburg, W. Va	26-27			0.33				0.31													
Pensacola, Fla	26-27			1.11														0.40			
Peoria, Ill	23	3:35 p. m.	6:40 p. m.	0.59	6:03 p. m.	6:16 p. m.	0.20	0.16	0.33	0.37											
Philadelphia, Pa	30			0.90														0.43			
Pittsburg, Pa	8			0.97														0.37			
Portland, Me	28			0.37														0.10			
Portland, Oreg	22-23			0.86														0.30			
Pueblo, Colo	28			0.02				0.01													
Raleigh, N. C	30	9:42 a. m.	11:15 a. m.	0.53	10:32 a. m.	10:55 a. m.	0.05	0.07	0.09	0.09	0.24	0.46									
Richmond, Va	8			0.33					0.32												
Rochester, N. Y	8			0.25														0.11			
Sacramento, Cal	21-22			0.05									0.01								
St. Louis, Mo	23-24			1.14														0.35			
St. Paul, Minn	24			1.59														0.28			
Salt Lake City, Utah	22-23			0.48														*			
San Antonio, Tex	10-11	9:30 p. m.	2:30 p. m.	1.00	12:37 a. m.	12:51 a. m.	0.03	0.46	0.74	0.80											
San Diego, Cal	22			0.35														0.20			
Sandusky, Ohio	7-8			0.63														0.22			
San Francisco, Cal	21			0.10					0.02												
Savannah, Ga	30			0.63														0.47			
Scranton, Pa	27			0.68					0.44												
Seattle, Wash	16-17			1.21														0.15			
Shreveport, La	15	12:35 a. m.	5:00 a. m.	1.02	3:36 a. m.	3:55 a. m.	0.43	0.18	0.28	0.51	0.58										
Spokane, Wash	15			0.17														0.12			
Springfield, Ill	23-24			1.31														0.44			
Springfield, Mo	7	12:45 a. m.	10:45 a. m.	1.52	6:11 a. m.	6:36 a. m.	0.25	0.05	0.17	0.30	0.63	0.81									
Syracuse, N. Y	18			0.34														0.16			
Tampa, Fla	28	5:45 a. m.	8:30 a. m.	1.27	6:13 a. m.	7:03 a. m.	0.05	0.06	0.29	0.34	0.36	0.39	0.45	0.66	0.97	1.11	1.17				
Taylor, Tex	14			0.87														0.59			
Thomasville, Ga	16			0.52						0.45											
Toledo, Ohio	15			0.81														0.22			
Topeka, Kans	17			0.70														0.42			
Valentine, Nebr	23			0.47														0.31			
Vicksburg, Miss	24	2:53 a. m.	5:15 a. m.	0.99	3:35 a. m.	4:12 a. m.	0.17	0.28	0.35	0.45	0.52	0.58	0.60	0.66	0.72						
Washington, D. C	8-9			0.51														0.24			
Wichita, Kans	21			1.07														0.60			
Wilmington, N. C	15-16			0.61														0.29			
Wytheville, Va	25			0.46				0.25													
Yankton, S. Dak	16-17			1.23														*			
San Juan, P. R	28	4:50 p. m.	5:30 p. m.	0.64	4:50 p. m.	5:25 p. m.	T.	0.14	0.26	0.31	0.47	0.57	0.63								

*Self-register not working. † Estimated.

TABLE III.—*Data furnished by the Canadian Meteorological Service, April, 1908.*

Stations.	Pressure. Actual, reduced to mean of 24 hours.	Pressure. Sea level, reduced to mean of 24 hours.	Pressure. Departure from normal.	Temperature. Mean.	Temperature. Departure from normal.	Temperature. Mean maximum.	Temperature. Mean minimum.	Precipitation. Total.	Precipitation. Departure from normal.	Precipitation. Total snowfall.
	Ins.	*Ins.*	*Ins.*	°	°	°	°	*Ins.*	*Ins.*	*Ins.*
St. Johns, N. F	29.56	29.70	—.19	32.4	— 2.1	38.2	26.7	6.20	+2.04	4.5
Sydney, C. B. I	29.72	29.76	—.13	33.1	— 1.9	40.5	26.7	6.35	+2.50	12.0
Halifax, N. S	29.69	29.80	—.16	36.4	— 0.4	44.5	28.3	6.38	+2.20	7.9
Grand Manan, N. B	29.73	29.78	—.16	38.0	— 1.2	45.9	30.0	3.86	+0.90	5.2
Yarmouth, N. S	29.76	29.83	—.13	38.1	— 0.8	44.3	31.8	5.61	+2.22	4.0
Charlottetown, P. E. I	29.70	29.74	—.16	33.0	— 2.2	39.5	26.6	4.69	+2.04	18.3
Chatham, N. B	29.71	29.73	—.17	35.1	— 0.4	45.2	25.0	2.75	+0.12	15.9
Father Point, Que	29.74	29.76	—.17	29.7	— 3.5	36.7	22.6	2.61	+1.03	7.6
Quebec, Que	29.49	29.82	—.17	31.5	— 3.6	39.8	23.2	2.46	+0.37	12.9
Montreal, Que	29.64	29.85	—.15	37.1	— 2.6	44.9	29.4	2.78	+0.54	8.7
Rockliffe, Ont	29.26	29.89	—.13	33.8	— 4.1	44.2	23.5	1.23	—0.33	9.9
Ottawa, Ont	29.58	29.90	—.12	36.6	— 3.4	44.5	28.8	1.72	+0.22	5.0
Kingston, Ont	29.61	29.93	—.09	38.8	— 1.2	46.4	31.3	1.70	—0.09	0.5
Toronto, Ont	29.54	29.93	—.09	41.8	+ 1.0	50.1	33.5	2.30	—0.07	5.8
White River, Ont	......	......	......	30.0	— 3.0	......	......	2.80	+1.55	......
Port Stanley, Ont	29.29	29.95	—.07	40.6	— 0.4	48.2	33.1	1.83	—0.54	1.9
Southampton, Ont	29.19	......	......	40.2	+ 1.5	49.0	31.4	2.52	+0.72	2.9
Parry Sound, Ont	29.19	29.89	—.13	37.5	— 0.1	46.8	28.1	1.76	—0.15	3.5
Port Arthur, Ont	29.17	29.89	—.14	35.2	+ 1.7	45.1	25.4	2.82	+1.10	5.5
Winnipeg, Man	29.06	29.90	—.12	40.0	+ 4.1	51.5	28.5	1.75	+0.70	5.3
Minnedosa, Man	28.06	29.90	—.11	39.3	+ 3.3	52.4	26.2	1.31	+0.25	6.5
Regina, Sask	27.89	......	......	39.9	+ 2.5	52.7	27.1	1.26	+0.21	1.6
Medicine Hat, Alberta	27.58	29.87	—.06	48.6	+ 4.1	62.4	34.9	0.05	—0.69	0.5
Swift Current, Sask	27.34	29.92	—.04	43.5	+ 2.2	57.3	29.7	0.54	—0.41	1.9
Calgary, Alberta	26.34	29.88	—.02	43.2	+ 3.6	57.9	28.4	0.87	+0.23	6.4
Banff, Alberta	25.30	29.92	+.02	38.2	+ 2.9	48.3	28.1	1.66	+0.58	6.2
Edmonton, Alberta	27.55	29.86	—.03	42.4	+ 2.5	54.3	30.4	0.57	—0.31	1.5
Prince Albert, Sask	......	......	......	......	......	......	......	......	......	......
Battleford, Sask	28.13	29.88	—.09	39.4	+ 2.2	51.8	27.0	0.34	—0.13	T.
Kamloops, B. C	......	......	......	48.8	— 0.1	59.8	37.8	0.26	—0.13	....
Victoria, B. C	29.99	30.09	+.08	48.5	+ 1.7	55.9	41.1	0.63	—1.74	....
Barkerville, B. C	25.59	29.95	+.09	31.9	— 1.2	39.3	24.5	2.99	+1.17	....
Hamilton, Bermuda	29.98	30.15	+.10	65.4	+ 1.5	70.6	60.2	4.32	+0.14	....
Dawson, Yukon	......	......	......	......	......	......	......	......	......	....

TABLE IV.—*Heights of rivers referred to zeros of gages, April, 1908.*

Stations.	Distance to mouth of river.	Flood stage on gage.	Highest water. Height.	Highest water. Date.	Lowest water. Height.	Lowest water. Date.	Mean stage.	Monthly range.
	Miles.	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
Republican River.								
Clay Center, Kans	42	18	5.8	1,2	5.5	25–30	5.6	0.3
Smoky Hill-Kansas River.								
Abilene, Kans	254	22	1.9	20	0.0	12–14,16	0.4	1.9
Manhattan, Kans	160	18	4.1	20	2.9	6,13	3.3	1.2
Topeka, Kans	87	21	6.6	22	5.7	{4–7, 14–16, 30}	6.0	0.9
Missouri River.								
Townsend, Mont	2,504	11	5.9	22–25	4.2	1–4	5.1	1.7
Fort Benton, Mont	2,285	12	6.4	16	2.4	28–30	3.0	4.0
Wolfpoint, Mont. (*)	1,952	17	3.8	21	0.3	18,19	2.0	3.5
Bismarck, N. Dak	1,309	14	6.8	6,7,13	3.0	25	5.1	3.8
Pierre, S. Dak	1,114	14	5.2	15	0.8	2	2.2	4.4
Sioux City, Iowa	784	17	9.9	18	6.5	2	7.5	3.4
Blair, Nebr	705	15	9.3	19	5.9	3–10	6.9	3.4
Omaha, Nebr	669	18	11.9	19,20	8.7	6	9.7	3.2
Plattsmouth, Nebr	641	17	5.8	20	3.0	5	3.9	2.8
St. Joseph, Mo	481	10	4.7	21	1.5	12	2.4	3.2
Kansas City, Mo	388	21	11.4	22	8.5	6–8,13,14	9.3	2.9
Glasgow, Mo	231	18	8.1	24	4.8	14	5.9	3.3
Boonville, Mo	199	20	11.6	24	8.3	15	9.5	3.3
Hermann, Mo	103	24	15.4	14,15	7.6	1	11.3	7.8
Minnesota River.								
Mankato, Minn	127	18	6.9	29,30	5.0	12,16,17	5.4	1.9
St. Croix River.								
Stillwater, Minn	23	11	9.6	30	5.5	21	6.2	4.1
Illinois River.								
La Salle, Ill	197	18	21.0	1	17.8	23,24	19.4	3.2
Peoria, Ill	135	14	17.5	1	14.6	25	15.7	2.9
Conemaugh River.								
Johnstown, Pa	64	7	7.0	19	2.4	29,30	3.5	4.6
Allegheny River.								
Warren, Pa	177	14	5.8	20,21	1.8	30	3.5	4.0
Parker, Pa	73	20	6.5	21	2.8	30	4.7	3.7
Freeport, Pa	29	20	11.0	9,10,21	5.3	30	8.5	5.7
Springdale, Pa	17	—	15.5	10	9.8	30	12.7	5.7
Youghiogheny River.								
Confluence, Pa	59	10	6.5	11	1.1	30	2.6	5.4
West Newton, Pa	15	23	9.2	11	2.0	30	3.9	7.2
Monongahela River.								
Fairmont, W. Va	119	25	20.2	1	14.6	27	16.7	5.6
Greensboro, Pa	81	18	14.7	1	7.8	29,30	10.0	6.9
Lock No. 4, Pa	40	28	19.0	1	8.2	30	12.1	10.8
Muskingum River.								
Zanesville, Ohio	70	25	17.4	9	9.4	30	12.0	8.0
Little Kanawha River.								
Creston, W. Va	38	20	13.7	1	2.6	30	5.4	11.1
New-Great Kanawha River.								
Hinton, W. Va	153	14	9.5	2	3.0	25	4.5	6.5
Charleston, W. Va	58	30	31.0	2	5.4	26	10.3	25.6
Scioto River.								
Columbus, Ohio	110	17	9.7	9	2.0	28,29	4.0	7.7
Licking River.								
Falmouth, Ky	30	25	30.0	1,2	3.7	30	10.8	26.3
Kentucky River.								
Beattyville, Ky	254	30	30.0	2	1.7	24	6.0	28.3
Frankfort, Ky	65	31	30.0	2	7.4	24	12.5	22.6
Wabash River.								
Terre Haute, Ind	171	16	14.7	14	6.0	22–24	9.5	8.7
Mount Carmel, Ill	75	15	18.5	15,16	9.1	25	14.6	9.4
Cumberland River.								
Burnside, Ky	518	50	24.5	3	4.4	24	11.0	20.1
Celina, Tenn	383	45	25.0	4	7.8	24	15.2	17.2
Carthage, Tenn	308	40	20.9	6	6.8	24	12.2	14.1
Nashville, Tenn	193	40	26.5	6	12.0	24	17.4	14.5
Clarksville, Tenn	126	43	34.6	8	13.8	23	20.9	20.8
Clinch River.								
Speers Ferry, Va	156	20	13.0	3	0.5	23,24	2.3	12.5
Clinch River—Cont'd.								
Clinton, Tenn	52	25	21.6	4	5.6	23,24	9.0	16.0
South Fork Holston River.								
Bluff City, Tenn	35	12	7.0	2	1.5	24	2.6	5.5
Holston River.								
Rogersville, Tenn	103	14	13.0	3	2.6	24	4.2	10.4
French Broad River.								
Asheville, N. C	144	4	2.9	26	0.2	14,15	0.8	2.7
Dandridge, Tenn	46	12	8.4	26	1.5	15	2.5	6.9
Tennessee River.								
Knoxville, Tenn	635	12	11.9	4	2.6	24	4.8	9.3
Loudon, Tenn	590	25	9.5	28	2.8	24,25	4.5	6.7
Kingston, Tenn	556	25	10.5	4	3.7	15,24	5.5	6.8
Chattanooga, Tenn	452	33	14.3	6	5.8	14,15	8.6	8.5
Bridgeport, Ala	402	24	11.5	6	4.0	15	6.4	7.5
Guntersville, Ala	349	31	16.8	7	6.7	14,15	10.7	10.1
Florence, Ala	255	16	9.7	8	4.2	17,18	6.7	5.5
Riverton, Ala	225	26	15.5	8	6.8	18	10.9	8.7
Johnsonville, Tenn	95	21	19.5	1	8.4	18	12.9	11.1
Ohio River.								
Pittsburg, Pa	966	22	12.6	12	3.4	30	7.9	9.2
Coraopolis, Pa	956	25	12.7	12	5.5	30	8.8	7.2
Beaver Dam, Pa	937	27	19.1	12	7.7	30	13.3	11.4
Wheeling, W. Va	875	36	18.6	11	7.9	30	10.3	10.7
Parkersburg, W. Va	785	36	23.1	12	9.0	29,30	15.0	14.1
Point Pleasant, W. Va	703	39	41.1	3	10.8	30	22.2	30.3
Huntington, W. Va	660	50	51.0	3	16.0	30	28.3	35.0
Catlettsburg, Ky	651	50	52.9	3	16.0	30	29.2	36.9
Portsmouth, Ohio	612	50	54.0	3	17.0	30	31.0	37.0
Maysville, Ky	559	50	52.6	3	18.0	30	31.7	34.6
Cincinnati, Ohio	499	50	55.9	4	21.5	30	35.8	34.4
Madison, Ind	413	46	48.1	5	21.1	30	32.0	27.0
Louisville, Ky	367	28	31.3	5,6	9.1	30	15.7	22.2
Evansville, Ind	184	35	42.2	8,9	23.7	20,30	34.1	18.5
Mount Vernon, Ind	148	35	41.8	10	23.3	28,29	34.2	18.5
Paducah, Ky	47	40	39.7	12	26.2	29	34.1	13.5
Cairo, Ill	1	45	45.3	13,14	35.0	29,30	40.7	10.3
Neosho River.								
Iola, Kans	262	10	4.2	8	0.1	2–6	0.9	4.1
Oswego, Kans	184	20	16.7	10	0.8	6	3.3	15.9
Fort Gibson, Okla	3	22	29.0	13	10.0	1	16.1	19.0
Canadian River.								
Calvin, Okla	99	10	6.0	24	3.2	4	4.5	2.8
Black River.								
Blackrock, Ark	67	12	23.0	19,20	10.6	2,3	18.8	12.4
White River.								
Calicorock, Ark	272	18	26.5	12	4.3	1	12.0	22.2
Batesville, Ark	217	18	26.5	13	-5.2	1	14.4	21.3
Clarendon, Ark	75	30	29.9	24,25	25.4	12–14	27.2	4.5
Arkansas River.								
Wichita, Kans	832	10	— 1.3	25	— 2.1	16,17	—1.8	0.8
Tulsa, Okla	551	16	7.8	11	3.8	7–9	5.3	4.0
Webbers Falls, Okla	465	23	21.8	13	6.8	7,8	11.8	15.0
Fort Smith, Ark	403	22	25.0	13	6.0	1	14.4	19.0
Dardanelle, Ark	256	21	22.9	15	5.3	1	14.1	17.6
Little Rock, Ark	176	23	23.4	15	10.4	4	17.0	13.0
Pine Bluff, Ark	121	25	25.1	16	14.2	5	19.4	10.9
Yazoo River.								
Greenwood, Miss	175	38	28.8	1–3	16.5	30	23.0	12.3
Yazoo City, Miss	80	25	25.4	1,2	23.5	23,29,30	24.4	1.9
Ouachita River.								
Camden, Ark	304	39	31.9	4	18.7	21	26.7	13.2
Monroe, La	122	40	29.8	26	26.7	10–13	28.1	3.1
Red River.								
Denison, Tex	768	22	10.4	11	2.5	1	6.3	7.9
Arthur City, Tex	688	27	•22.0	12	12.6	30	16.7	9.4
Fulton, Ark	515	28	30.6	18	24.0	1	29.0	6.6
Shreveport, La	327	29	23.8	30	4.4	1	17.6	19.4

TABLE IV.—*Heights of rivers referred to zeros of gages*—Continued.

Stations.	Distance to mouth of river.	Flood stage on gage.	Highest water.		Lowest water.		Mean stage.	Monthly range.
			Height.	Date.	Height.	Date.		
Red River—Cont'd.	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
Alexandria, La.	118	33	30.4	30	13.3	2	24.4	17.1
Mississippi River.								
Fort Ripley, Minn	2,082	10	6.4	28	4.5	1,4	5.1	1.9
St. Paul, Minn.	1,954	14	7.1	30	4.8	21	5.4	2.3
Red Wing, Minn.	1,914	14	6.8	30	3.7	5–7	4.5	3.1
Reeds Landing, Minn.	1,884	12	6.7	30	3.4	7,8	4.4	3.3
La Crosse, Wis.	1,819	12	6.9	30	4.6	6,7	5.5	2.3
Prairie du Chien, Wis.	1,759	18	7.4	25–30	5.3	1–6	6.2	2.1
Dubuque, Iowa.	1,699	18	7.9	27–30	5.6	1–4	6.6	2.3
Clinton, Iowa	1,629	16	7.5	28,29	5.2	1	6.1	2.3
Leclaire, Iowa	1,609	10	4.4	26	2.8	1	3.4	1.6
Davenport, Iowa	1,593	15	7.1	30	5.4	1	6.0	1.7
Muscatine, Iowa	1,562	16	8.2	30	6.5	1,17	7.0	1.7
Galland, Iowa.	1,472	8	4.0	28–30	3.1	17–21	3.4	0.9
Keokuk, Iowa.	1,463	15	6.8	28,29	5.2	17, 18, 20	5.6	1.6
Warsaw, Ill	1,458	18	9.7	28	8.1	11	8.5	1.6
Hannibal, Mo	1,402	13	7.4	28	6.1	19–22	6.5	1.3
Grafton, Ill	1,306	23	12.2	9	10.2	23	11.4	2.0
St. Louis, Mo	1,264	30	20.1	13,15	14.5	2,3	16.8	5.6
Chester, Ill	1,189	30	18.2	13	12.3	3,7	14.9	5.9
Cape Girardeau, Mo.	1,128	28	24.0	14	17.6	4,7	20.2	6.4
New Madrid, Mo.	1,008	34	36.2	15	28.8	30	33.0	7.4
Luxora, Ark	905	33	29.5	18	22.4	30	26.9	7.1
Memphis, Tenn	843	33	35.2	20	29.5	30	32.9	5.7
Helena, Ark.	767	42	44.6	22,23	41.0	30	42.9	3.6
Arkansas City, Ark.	635	42	49.3	25–28	46.6	13,14	48.0	2.7
Greenville, Miss.	595	42	43.9	26–28	40.8	14	42.4	3.1
Vicksburg, Miss.	474	45	47.5	27–30	45.9	13–16	46.6	1.6
Natchez, Miss.	373	46	47.8	30	46.4	16–20	46.9	1.4
Baton Rouge, La.	240	35	36.6	30	35.0	1	35.6	1.6
Donaldsonville, La	188	28	29.2	30	27.9	1	28.4	1.3
New Orleans, La.	108	16	18.6	28	17.8	3,18	18.1	0.8
Atchafalaya River.								
Simmesport, La.	127	33	41.8	30	39.5	1	40.6	2.3
Melville, La.	103	31	37.7	30	36.7	1,2	37.1	1.0
Hudson River.								
Troy, N. Y.	154	14	10.0	1	7.0	24,25	8.4	3.0
Albany, N. Y.	147	12	9.1	1	4.3	24	6.8	4.8
Delaware River.								
Hancock (E. Branch), N. Y.	287	12	6.9	9	4.3	27,30	5.0	2.6
Hancock (W. Branch), N. Y.	287	10	6.6	9	4.2	26, 27, 30	4.9	2.4
Port Jervis, N. Y.	215	14	5.5	10	1.8	27	3.5	3.7
Phillipsburg, N. J.	146	26	8.2	1	3.5	26–28	5.0	4.7
Trenton, N. J.	92	18	7.1	1	2.7	22, 29, 30	3.7	4.4
North Branch Susquehanna.								
Binghamton, N. Y.	183	14	7.1	1,10	3.5	27	5.0	3.6
Wilkes-Barre, Pa.	60	17	14.9	1	6.6	29	9.0	8.3
West Branch Susquehanna.								
Williamsport, Pa.	39	20	8.3	1	3.2	30	5.2	5.1
Susquehanna River.								
Harrisburg, Pa.	69	17	9.8	1	3.8	30	5.4	6.0
Shenandoah River.								
Riverton, Va.	58	22	−0.4	1–3	−0.8	17–30	−0.7	0.4
Potomac River.								
Cumberland, Md.	290	8	5.5	11	3.2	26–30	3.8	2.3
Harpers Ferry, W. Va.	172	18	6.4	3	1.8	25,26	3.7	4.6
James River.								
Lynchburg, Va.	260	20	6.7	2	2.1	20–25	2.9	4.6
Columbia, Va.	167	18	13.6	2	5.6	27	7.2	8.0
Richmond, Va.	111	10	5.2	3	−0.2	12	1.5	5.4
Roanoke River.								
Clarksville, Va	196	12	3.0	4	1.0	15,30	1.5	2.0
Weldon, N. C.	129	30	17.4	5	12.6	28,30	14.0	4.8
Tar River.								
Greenville, N. C.	21	22	14.5	1	5.1	30	7.6	9.4
Deep River.								
Moncure, N. C.	171	25	12.0	2	7.9	14	8.6	4.1
Cape Fear River.								
Fayetteville, N. C.	112	38	20.7	3	5.9	15,30	9.6	14.8
Pedee River.								
Cheraw, S. C.	149	27	9.4	18	4.0	16	5.4	5.4
Smiths Mills, S. C.	51	16	16.5	2,3	9.0	18	12.1	7.5
Lynch Creek.								
Effingham, S. C.	35	12	11.8	1	4.0	15,16	6.6	7.8
Black River.								
Kingstree, S. C.	45	12	7.7	29,30	1.7	16	4.6	6.0
Catawba-Wateree River.	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
Mount Holly, N. C.	143	15	4.0	17	1.8	10–15	2.1	2.2
Catawba, S. C.	107	11	4.0	18	2.4	15	3.0	1.6
Camden, S. C.	37	24	11.9	18	7.1	15	8.6	4.8
Congaree River.								
Columbia, S. C	52	15	3.8	28	1.5	26	2.4	2.3
Savannah River.								
Calhoun Falls, S. C.	347	15	8.2	27	3.0	13	4.6	5.2
Augusta, Ga.	268	32	24.0	27	8.9	11	13.0	15.1
Oconee River.								
Dublin, Ga	79	30	22.0	30	3.3	14	9.6	18.7
Ocmulgee River.								
Macon, Ga.	203	18	20.1	27	4.4	14	8.9	15.7
Abbeville, Ga.	96	11	16.1	30	6.4	16	10.6	9.7
Flint River.								
Montezuma, Ga.	152	20	23.2	29	5.4	15	9.5	17.8
Albany, Ga.	90	20	20.2	1	4.8	15	9.7	15.4
Bainbridge, Ga.	29	22	22.9	1	9.3	15	13.5	13.6
Chattahoochee River.								
West Point, Ga	239	20	15.8	26	3.2	14	6.0	12.6
Eufaula, Ala	90	40	47.0	29	6.0	6, 13–15	13.3	41.0
Alaga, Ala.	30	25	38.2	30	8.1	16	14.3	30.1
Coosa River.								
Rome, Ga.	266	30	15.0	26	3.0	13,14	5.6	12.0
Gadsden, Ala.	162	22	12.7	28	3.8	14	7.2	8.9
Lock No. 4, Ala.	113	17	10.0	28	3.4	14,15	5.9	6.6
Wetumpka, Ala	12	45	30.8	29	7.6	15	13.7	23.2
Alabama River.								
Montgomery, Ala.	323	35	31.4	29	5.3	15	11.8	26.1
Selma, Ala	246	35	35.5	30	7.1	15	15.1	28.4
Black Warrior River.								
Tuscaloosa, Ala.	90	43	22.8	1	9.0	15,24	13.8	13.8
Tombigbee River.								
Columbus, Miss	316	33	11.5	1	0.3	14,15	3.8	11.2
Demopolis, Ala.	168	35	47.0	1,2	8.3	15	23.3	38.7
Pascagoula River.								
Merrill, Miss.	78	20	20.4	29	6.0	14	11.2	14.4
Pearl River.								
Columbia, Miss.	110	18	18.2	28	7.6	15	11.9	10.6
Sabine River.								
Logansport, La.	315	25	20.9	26	6.4	7,14	12.0	14.5
Neches River.								
Beaumont, Tex.	18	10	5.9	18	1.2	11,12	3.6	4.7
Trinity River.								
Dallas, Tex.	320	25	40.2	20	8.8	9	25.3	31.4
Long Lake, Tex.	211	35	47.0	29	6.5	2	29.3	40.5
Liberty, Tex	20	25	25.8	30	8.3	7	16.5	17.5
Brazos River.								
Waco, Tex.	285	22	34.7	19	3.6	11	11.3	31.1
Hempstead, Tex	140	40	41.9	28	1.4	11	18.4	40.5
Booth, Tex	61	39	38.7	30	4.6	15	16.9	34.1
Colorado River.								
Austin, Tex.	214	18	22.0	23	1.0	10	4.5	21.0
Columbus, Tex.	98	24	35.8	27	5.7	10	13.3	30.1
Red River of the North.								
Moorhead, Minn	284	26	13.0	6	8.6	23,24	10.4	4.4
Snake River.								
Lewiston, Idaho	144	24	12.6	23	3.4	5	7.3	9.2
Riparia, Wash.	67	30	12.1	24	4.5	5,11	7.8	7.6
Columbia River.								
Wenatchee, Wash	473	40	18.5	30	6.4	9–11	10.0	12.1
Umatilla, Oreg	270	25	12.5	24,25	3.7	10	7.3	8.8
The Dalles, Oreg.	166	40	19.3	25	5.2	11	10.8	14.1
Rio Grande.								
San Marcial, N. Mex.	1,233	11	11.5	19	9.5	7	10.2	2.0
El Paso, Tex.	1,030	14	12.4	22	9.6	10	10.8	2.8
Willamette River.								
Albany, Oreg.	118	20	6.6	26	4.0	12	4.9	2.6
Portland, Oreg.	12	15	12.2	26,27	3.2	10	7.2	9.0
Sacramento River.								
Red Bluff, Cal.	265	23	4.9	25	3.3	9,10	3.9	1.6
Colusa, Cal	156	28	11.0	26	8.7	10,11	9.8	2.3
Knights Landing, Cal.	99	18	11.2	27	8.8	10,11	10.1	2.4
Sacramento, Cal.	64	25	17.2	22	15.2	4,9,10	16.3	2.0
San Joaquin River.								
Pollasky, Cal.	203	10	3.0	30	0.3	3	1.4	2.7
Firebaugh, Cal	148	14	5.2	30	0.3	5,6	2.2	4.9
Lathrop, Cal.	49	14	11.6	23	4.8	6,7	8.0	6.8

Figures denote number of days frozen.

Honolulu, T. H., latitude 21° 19' north, longitude 157° 30' west; barometer above sea, 38 feet; gravity correction, —0.057 inch, applied. April, 1908.

Day.	Pressure, in inches.*		Air temperature, degrees Fahrenheit.				Moisture.				Wind, in miles per hour.				Precipitation, inches.		Clouds.					
							8 a. m.		8 p. m.		8 a. m.		8 p. m.				8 a. m.			8 p. m.		
	8 a. m.	8 p. m.	8 a. m.	8 p. m.	Maximum.	Minimum.	Wet.	Relative humidity.	Wet.	Relative humidity.	Direction.	Velocity.	Direction.	Velocity.	8 a. m.	8 p. m.	Amount.	Kind.	Direction, from.	Amount.	Kind.	Direction, from.
							°	%	°	%												
1	30.08	30.07	74.2	72.5	78	68	65.5	62	64.5	65	ne.	12	ne.	14	0.00	0.03	4 3	Ci. Cu.	nw. e.	2	N.	e.
2	30.08	30.02	72.0	72.0	77	65	64.0	65	63.0	61	e.	17	ne.	17	0.04	0.00	2 5	A.-s. Cu.	0 e.	2	Cu.	ne.
3	30.05	30.05	69.2	72.0	75	65	65.0	80	63.5	63	ne.	12	e.	18	0.05	0.06	3 6	Cu. N.	e. e.	3	S.	e.
4	30.09	30.06	72.0	70.0	76	67	65.0	69	63.0	68	ne.	14	ne.	18	T.	T.	6	Cu.	e.	7	Cu.	se.
5	30.06	30.01	73.2	72.0	77	68	64.0	60	64.5	67	ne.	13	ne.	15	0.00	0.02	9 1	Ci. Cu.	w. e.	9 1	Ci.-s. Cu.	0 ne.
6	30.02	30.01	74.0	72.8	77	69	65.0	61	65.0	67	ne.	16	ne.	10	0.00	0.00	6 1	Ci. Cu.	0 e.	4	Cu.	e.
7	30.06	30.06	71.8	72.5	78	67	66.1	74	65.5	69	e.	8	ne.	16	T.	0.18	8	Cu.	e.	8	Cu.	e.
8	30.10	30.08	72.0	71.0	78	67	65.0	69	64.5	70	ne.	8	ne.	25	T.	0.02	5 3	A.-cu. N.	w. e.	8	Cu.	ne.
9	30.11	30.09	73.4	72.0	77	69	65.0	63	65.0	69	e.	18	e.	8	0.01	0.00	8 1	Ci.-s. Cu.	se. ne.	4 4	A.-s. Cu.	nw. e.
10	30.11	30.08	74.0	71.0	77	68	66.0	65	64.0	68	e.	17	ne.	9	0.00	T.	5	Cu.	ne.	9	Cu.	ne.
11	30.06	30.02	72.4	70.5	76	68	63.1	60	66.0	79	ne.	13	ne.	6	0.01	T.	4	Cu.	0	8 1	Cu. N.	ne. ne.
12	30.05	30.03	72.0	70.5	76	66	61.0	53	62.0	62	ne.	12	ne.	18	0.04	0.00	1	Cu.	e.	Few	Cu.	ne.
13	30.05	30.02	72.2	70.5	77	68	63.3	61	64.0	70	ne.	7	e.	5	0.00	0.00	3	Cu.	e.	3 5	Ci.-s. Cu.	0 e.
14	30.06	30.07	73.0	71.0	78	69	65.0	65	66.0	77	ne.	7	s.	4	0.00	0.00	6 4	A.-s. Cu.	w. e.	4 2	Ci. Cu.	sw. se.
15	30.11	30.11	73.7	72.0	77	70	66.0	66	64.0	65	ne.	17	e.	9	0.01	0.00	8 2	Ci. Cu.	0 e.	6 4	A.-s. Cu.	nw. ne.
16	30.10	30.10	72.4	70.0	76	69	63.0	60	62.0	64	ne.	16	e.	5	0.00	0.00	9	A.-s.	w.	9 1	A.-s. Cu.	sw. ne.
17	30.09	30.08	72.0	71.0	76	68	62.0	57	62.5	62	ne.	10	e.	4	0.00	0.00	9 1	Ci.-s. Cu.	sw. e.	1 9	Cu. S.	e. e.
18	30.14	30.13	72.0	71.5	77	67	65.0	69	63.5	64	ne.	8	ne.	12	0.01	0.00	9	S.-cu.	e.	8	Cu.	ne.
19	30.15	30.13	72.7	72.8	77	70	63.0	58	64.5	65	ne.	6	e.	10	0.00	0.02	3 7	Ci.-s. S.-cu.	0 e.	7	S.	ne.
20	30.17	30.12	70.0	71.0	75	67	65.0	77	64.0	68	ne.	5	e.	12	0.05	0.00	10	N.	e.	3	Cu.	ne.
21	30.14	30.06	73.0	71.0	77	68	64.0	61	63.0	64	ne.	14	e.	10	0.03	0.00	4	Cu.	e.	7	S.	ne.
22	30.09	30.04	74.0	72.5	77	69	64.0	58	64.0	63	e.	8	ne.	10	T.	0.00	4	Cu.	se.	2	A.-s.	n.
23	30.04	30.04	73.0	71.0	76	66	66.5	71	67.0	81	0	0	sw.	9	0.00	0.00	5	Cu.	ne.	9	S.	sw.
24	30.06	30.06	71.8	72.0	78	68	66.8	77	67.0	77	w.	3	ne.	4	0.00	0.00	10	A.-s.	ne.	2	S.	ne.
25	30.04	30.03	73.0	73.0	82	67	67.0	73	67.0	73	sw.	3	se.	3	0.00	0.00	1	S.-cu.	ne.	0	0	0
26	30.02	30.01	74.0	74.0	79	68	68.0	74	67.5	71	w.	4	nw.	5	0.00	0.00	1	S.-cu.	ne.	0	0	0
27	29.99	29.99	74.7	72.2	81	67	67.0	67	66.0	72	se.	3	ne.	15	0.00	0.00	7	Ci.-s.	w.	1	A.-s.	sw.
28	30.03	30.03	75.2	72.7	80	70	67.0	65	67.0	74	sw.	3	se.	2	0.00	0.00	3	Cu.	ne.	Few	S.-cu.	ne.
29	30.05	30.04	75.3	72.0	80	70	67.0	65	67.0	77	ne.	4	ne.	9	0.00	0.00	2	Cu.	e.	6	S.	ne.
30	30.07	30.08	74.0	73.0	79	70	66.0	65	65.0	65	ne.	9	e.	12	0.02	0.00	6	Cu.	ne.	Few	S.-cu.	ne.
31																						
Mean	30.076	30.057	72.9	71.7	77.5	67.9	65.0	65.7	64.7	68.7	ne.	9.6	ne.	10.5	0.27	0.33	6.5	Cu.	e.	5.2	Cu.	ne.

Observations are made at 8 a.m. and 8 p. m., local standard time, which is that of 157° 30' west, and is 5h and 30m slower than 75th meridian time. *Pressure values are reduced to sea level and standard gravity.

RAINFALL IN JAMAICA.

Thru the kindness of Mr. Maxwell Hall, meteorologist to the government of Jamaica and now in charge of the meteorological service of that island, we have received the following data:

Comparative table of rainfall.

[Based upon the average stations only.]

MARCH, 1908.

Divisions.	Relative area.	Number of stations.	Rainfall.	
			1908.	Average.
	Per cent.		*Inches.*	*Inches.*
Northeastern division	25	21	5.39	3.62
Northern division	22	49	1.86	2.07
West-central division	26	19	3.31	3.66
Southern division	27	30	3.14	2.15
Means	100	....	3.42	2.88

The rainfall over the Island for March, 1908, was above the average; the forecast issued early in the month was therefore verified. The maximum rainfall recorded was 19.07 inches at Shrewsbury, Portland, in the northeastern division; and the minimum rainfall recorded was 0.20 inch at Dry Harbour, in the northern division. At Gordon Town, Grand Cayman, the total rainfall for March, 1908, was 0.30 inch; it fell on the 21st.

The earthquake activity was less during March than during February, and much less than during January. The shocks had the same peculiarities as those pointed out in the last Weather Report. The two shocks at Kings Valley on the 3d were unusual and discomposing: The question arose as to what was coming next.

Chart I. Hydrographs for Seven Principal Rivers of the United States, April, 1908.

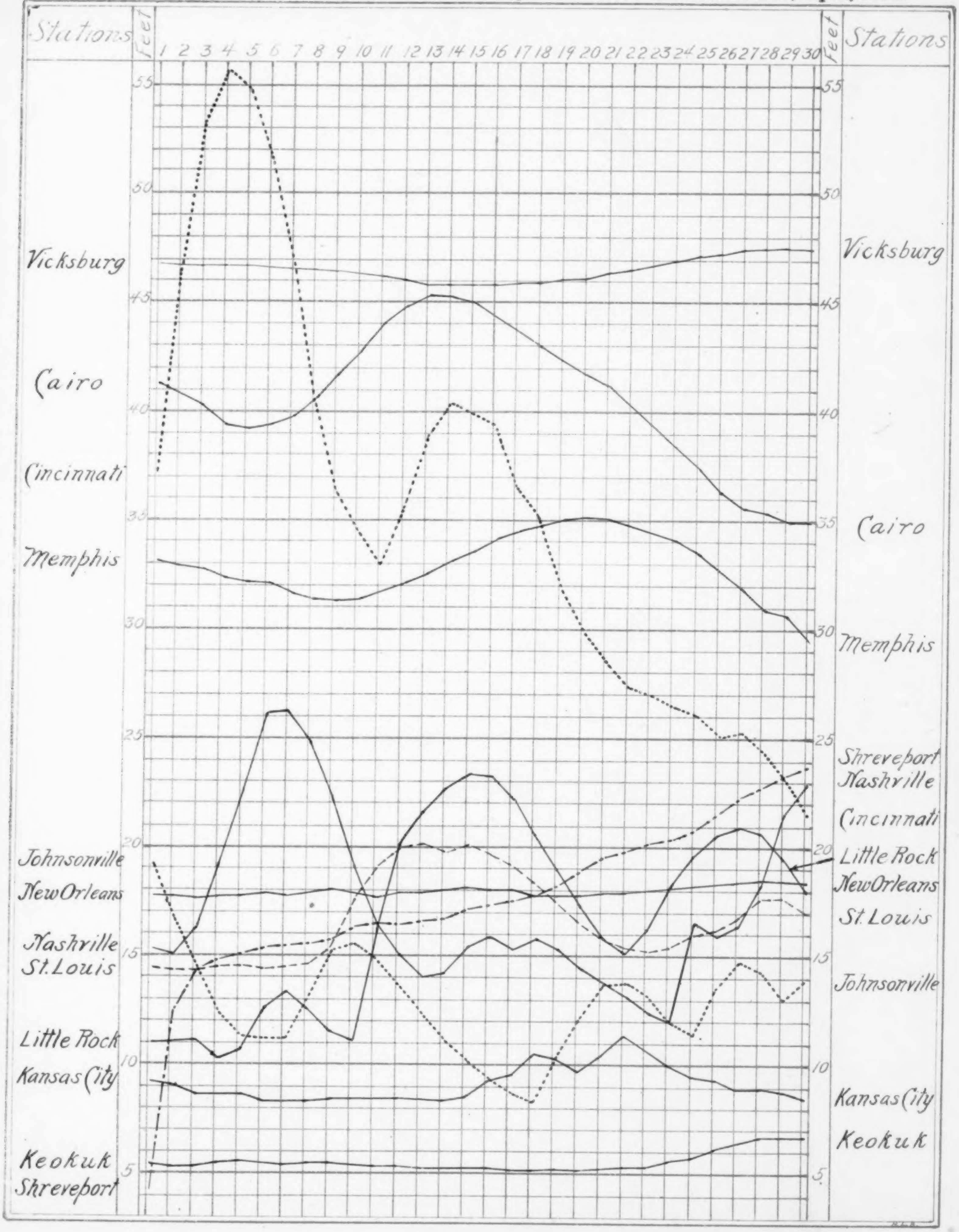


Chart II. Tracks of Centers of High Areas, April, 1908.

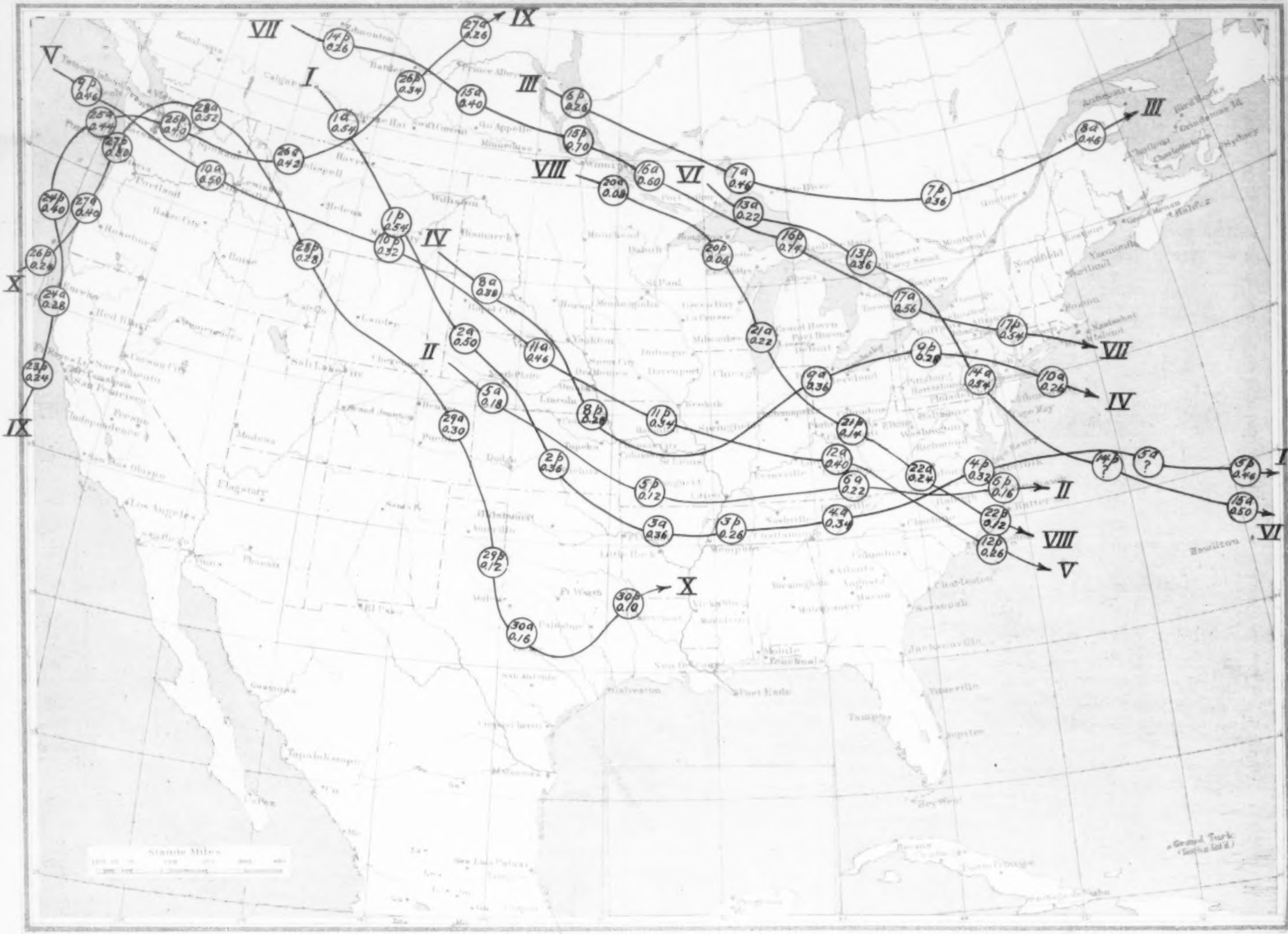


Chart III. Tracks of Centers of Low Areas, April, 1908.

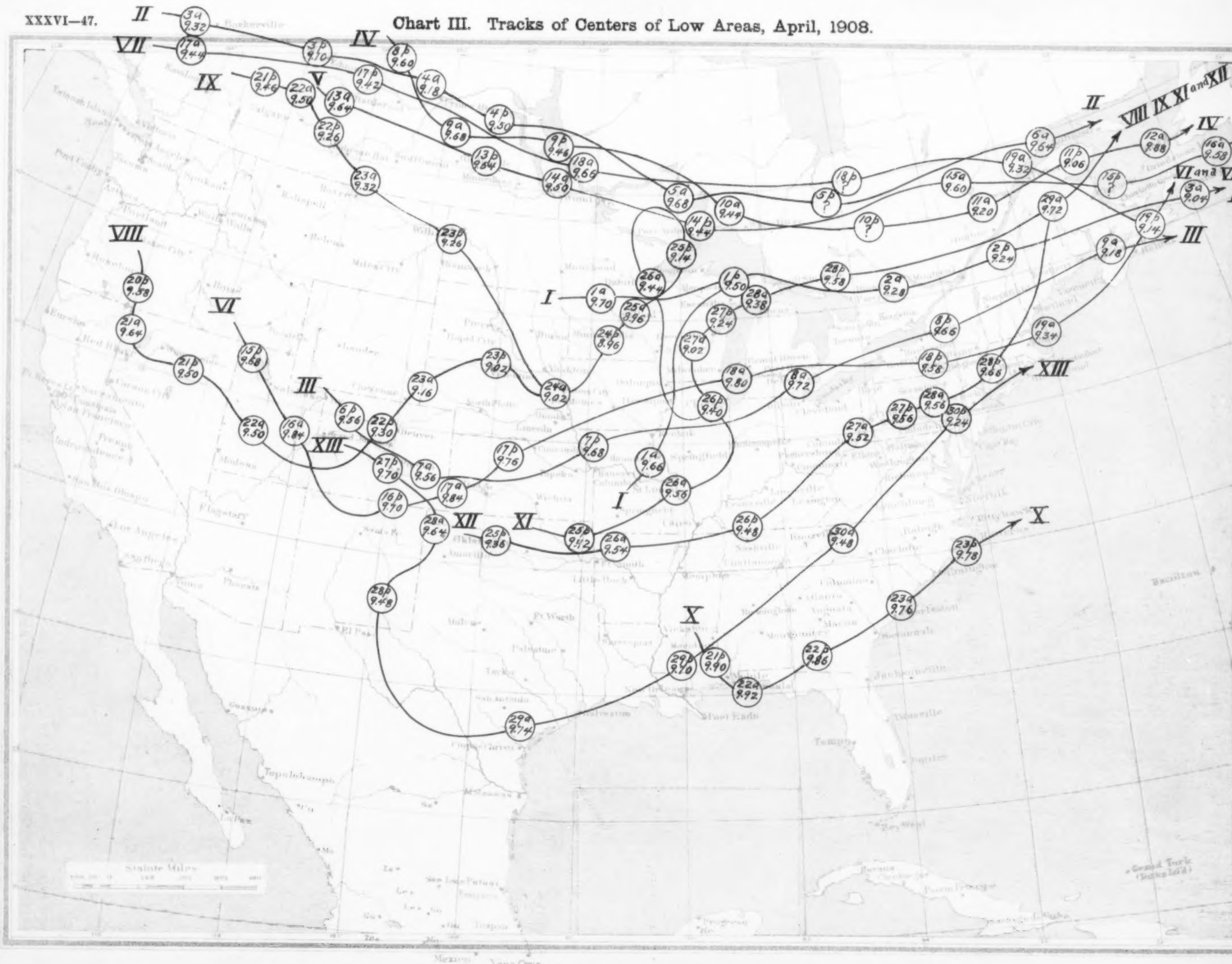


Chart IV. Total Precipitation, April, 1908.

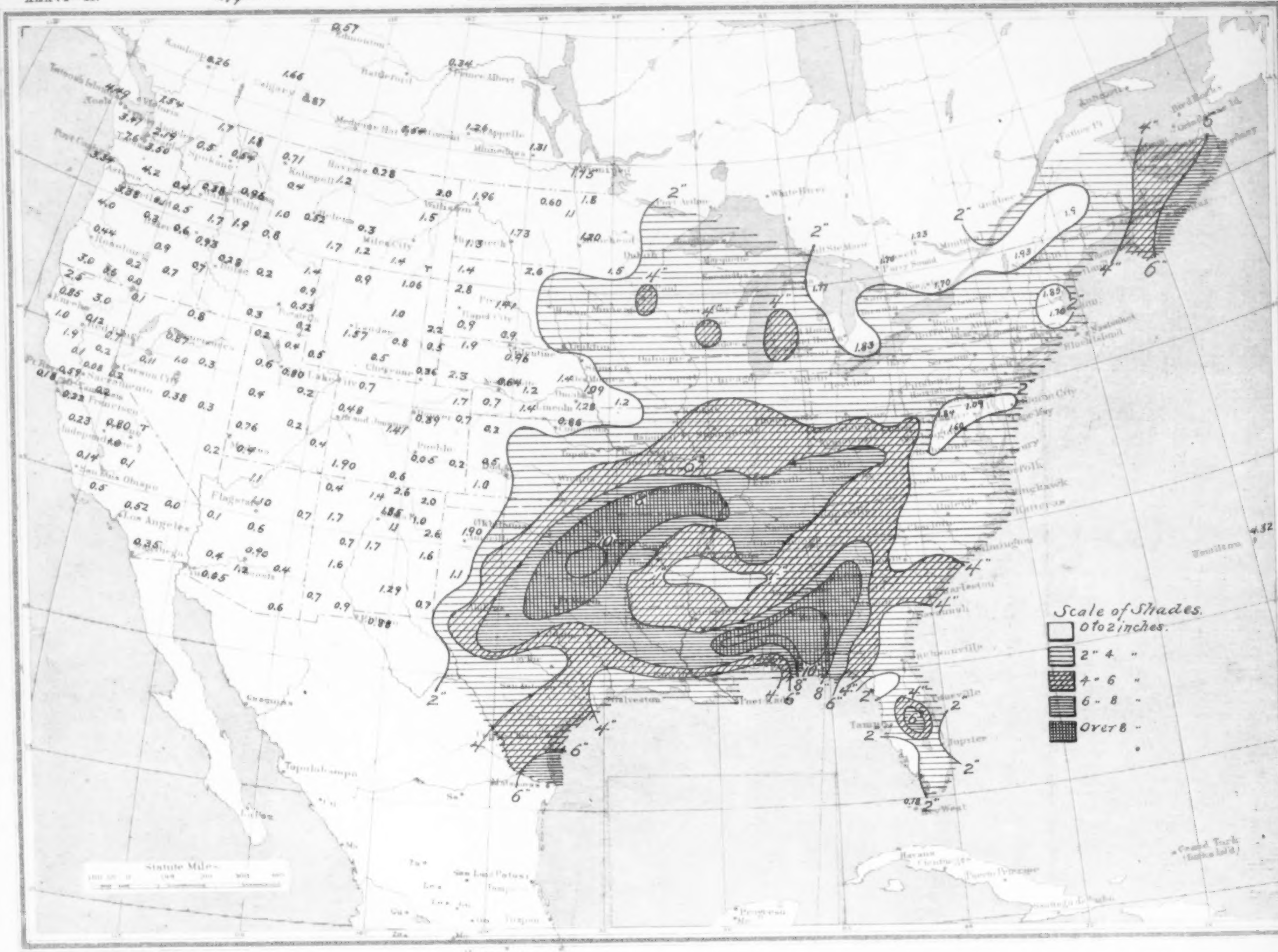


Chart V. Percentage of Clear Sky between Sunrise and Sunset, April, 1908.

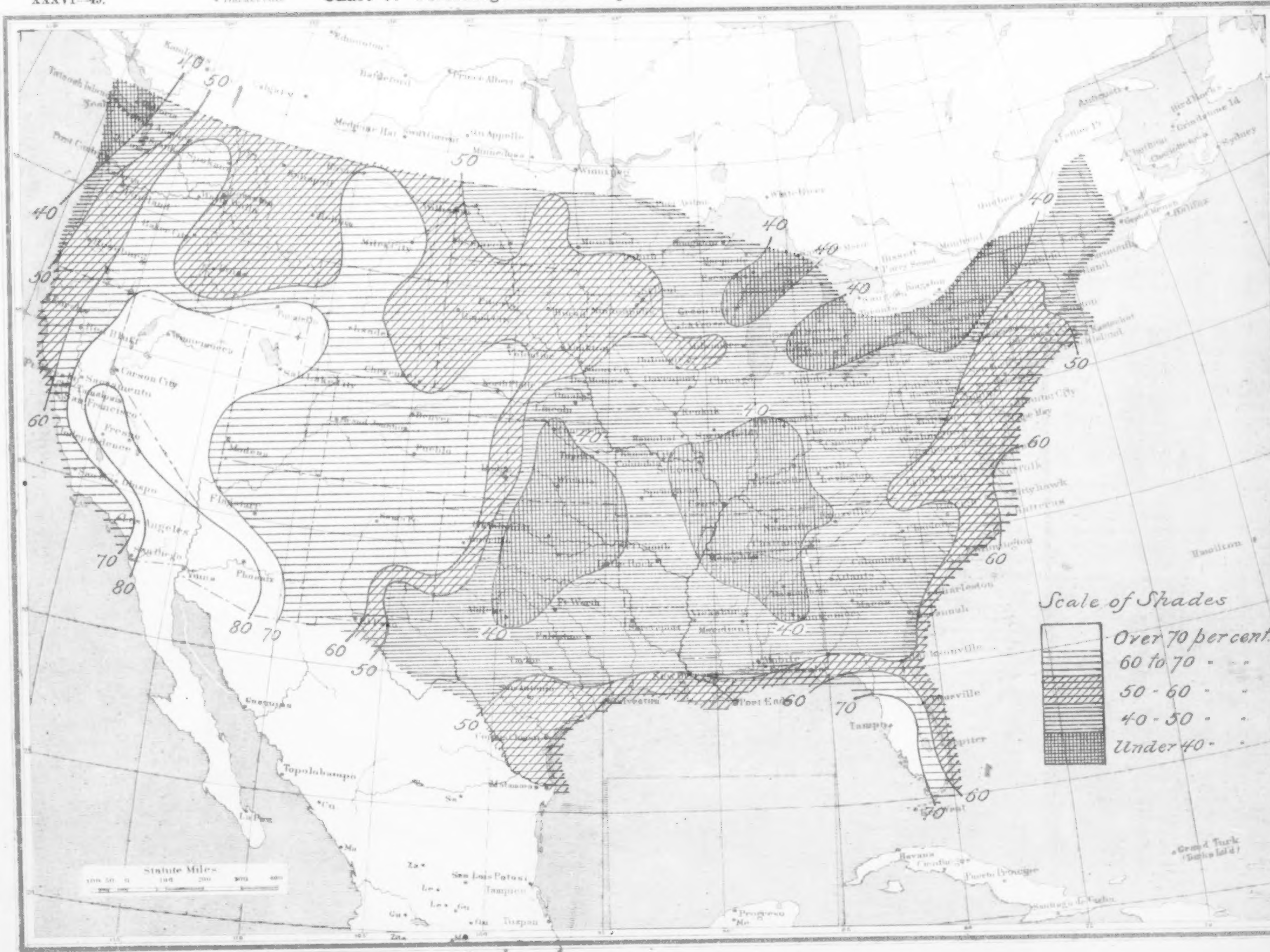


Chart VI. Isobars and Isotherms at Sea Level; Prevailing Winds, April, 1908.

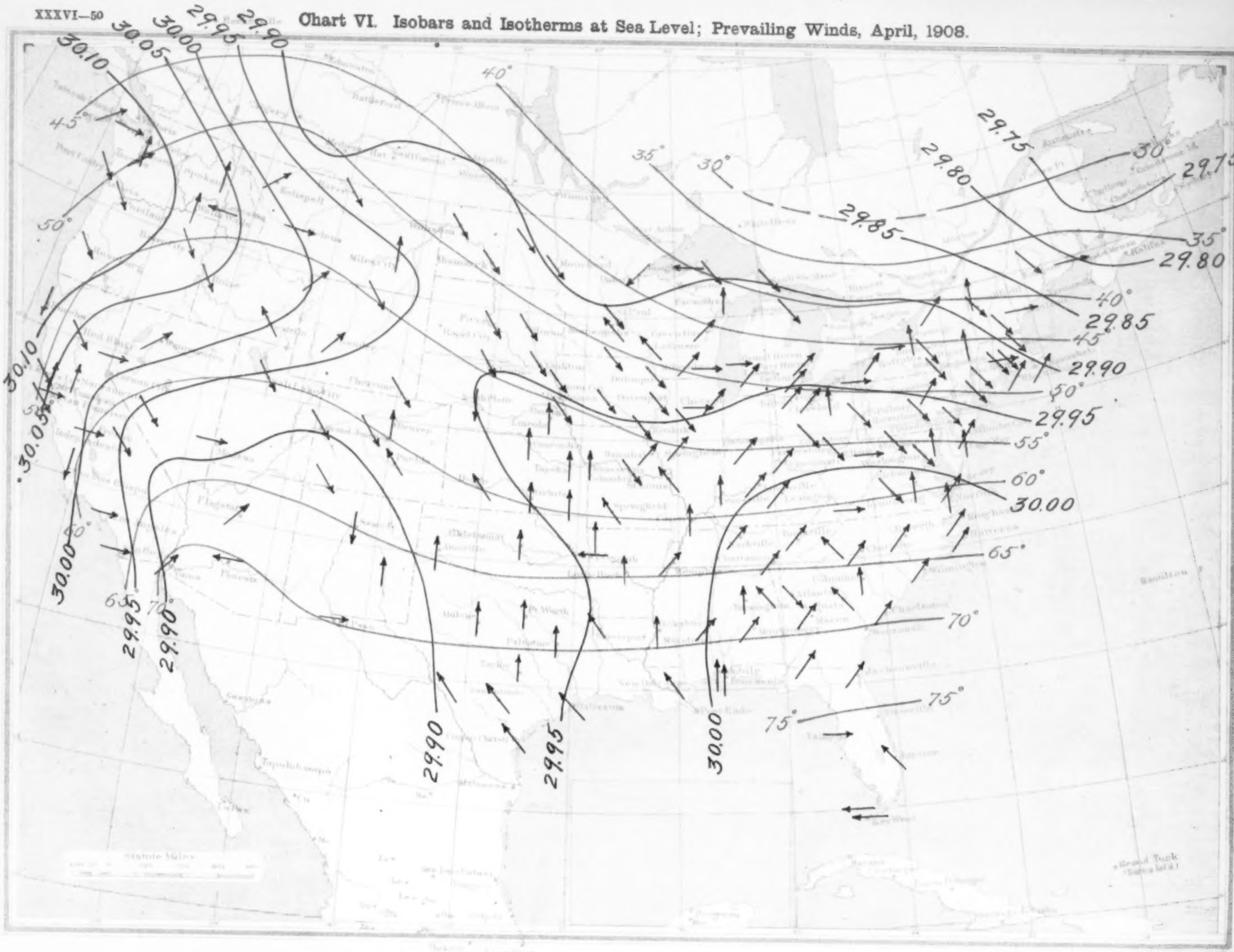


Chart VII. Total Snowfall for April, 1908.

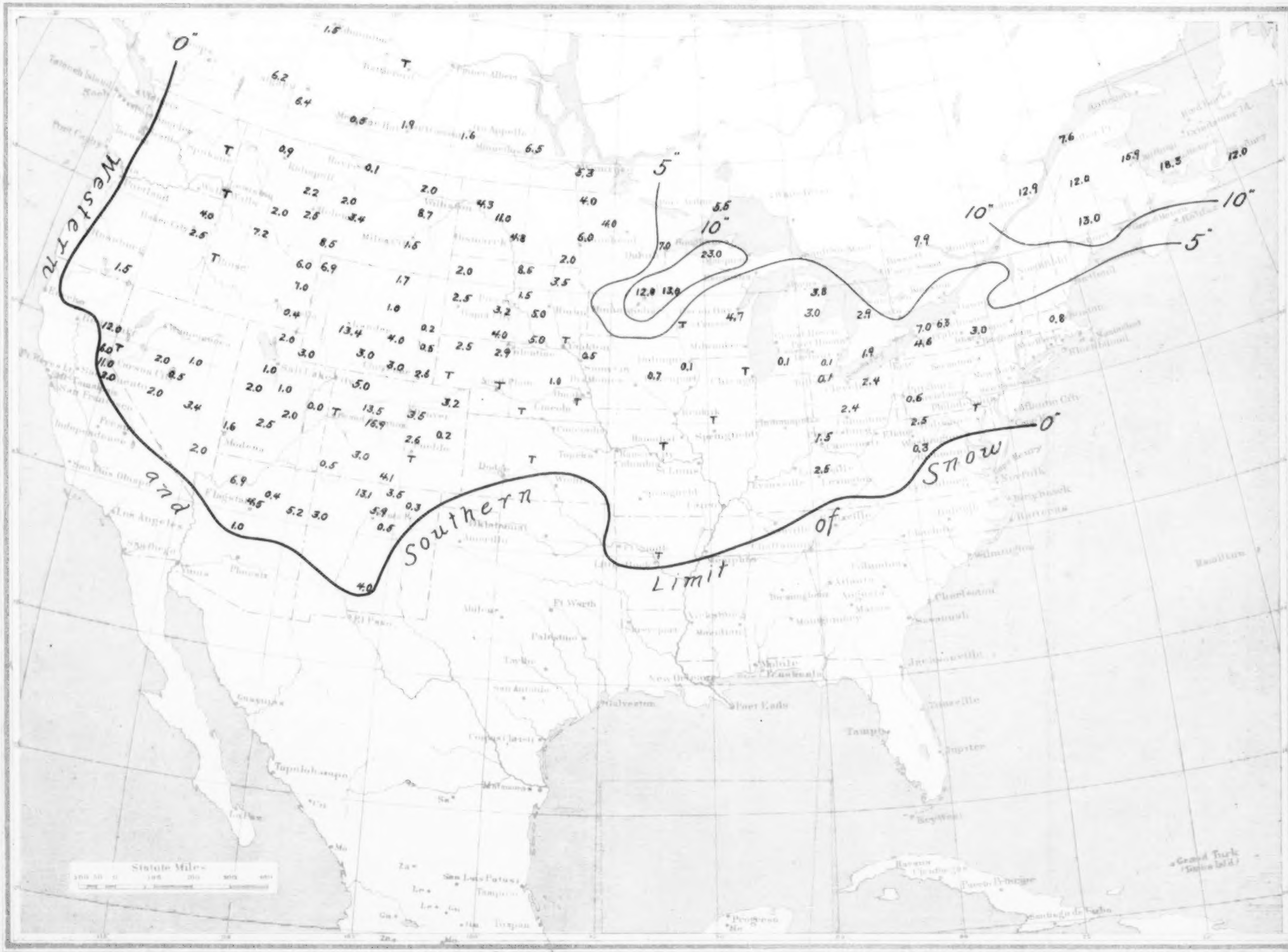
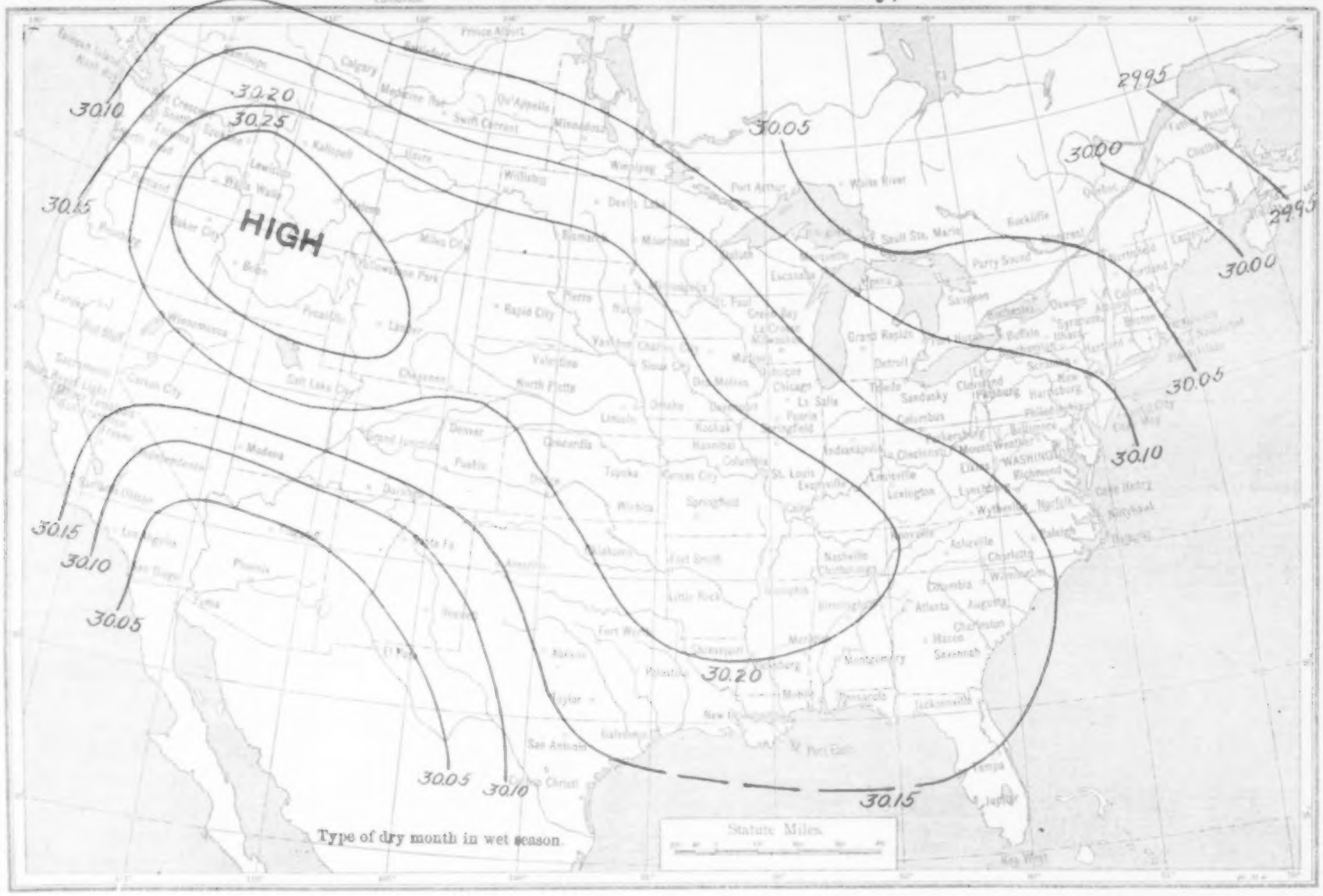
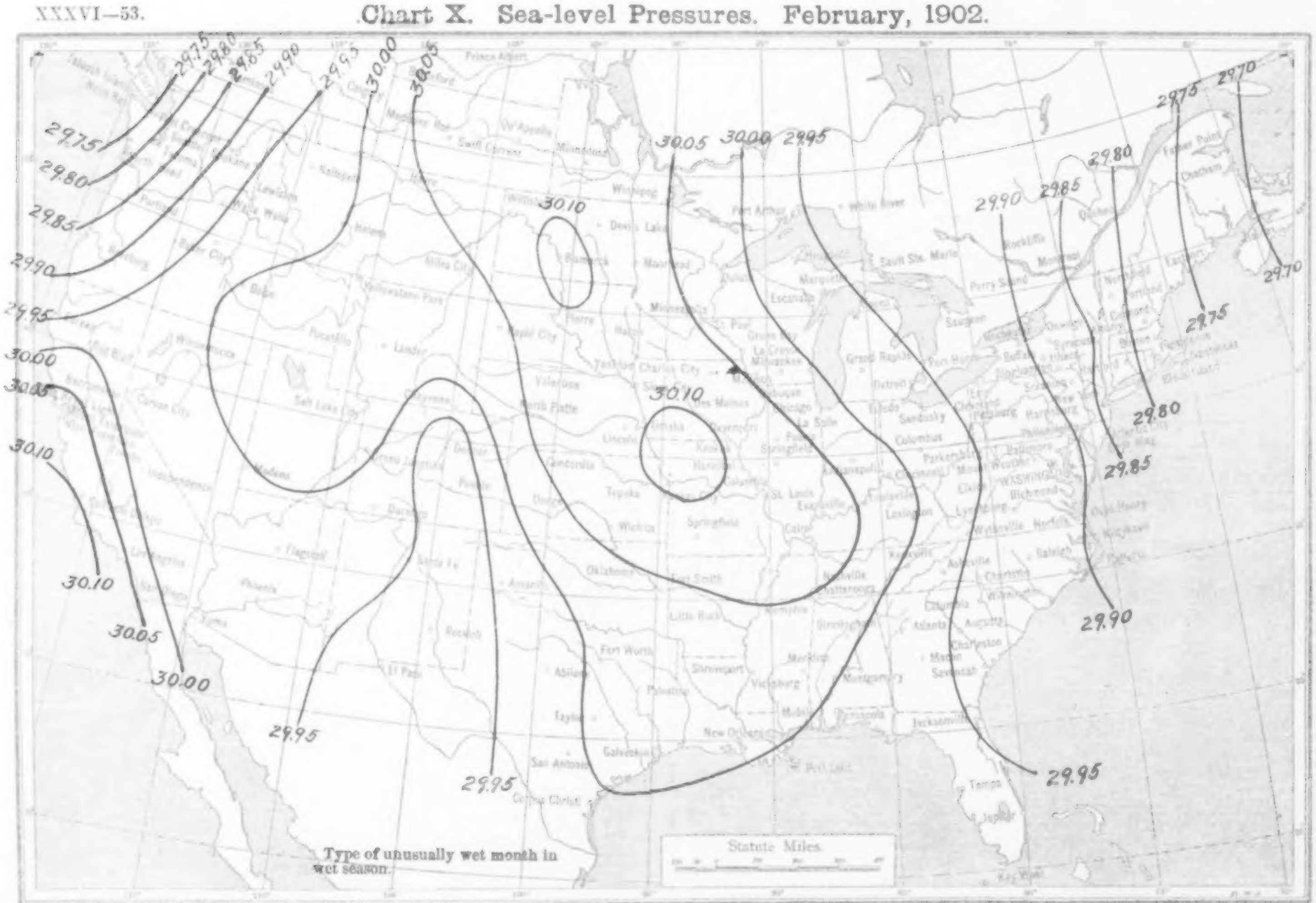


Chart IX. Sea-level Pressures. January, 1902.



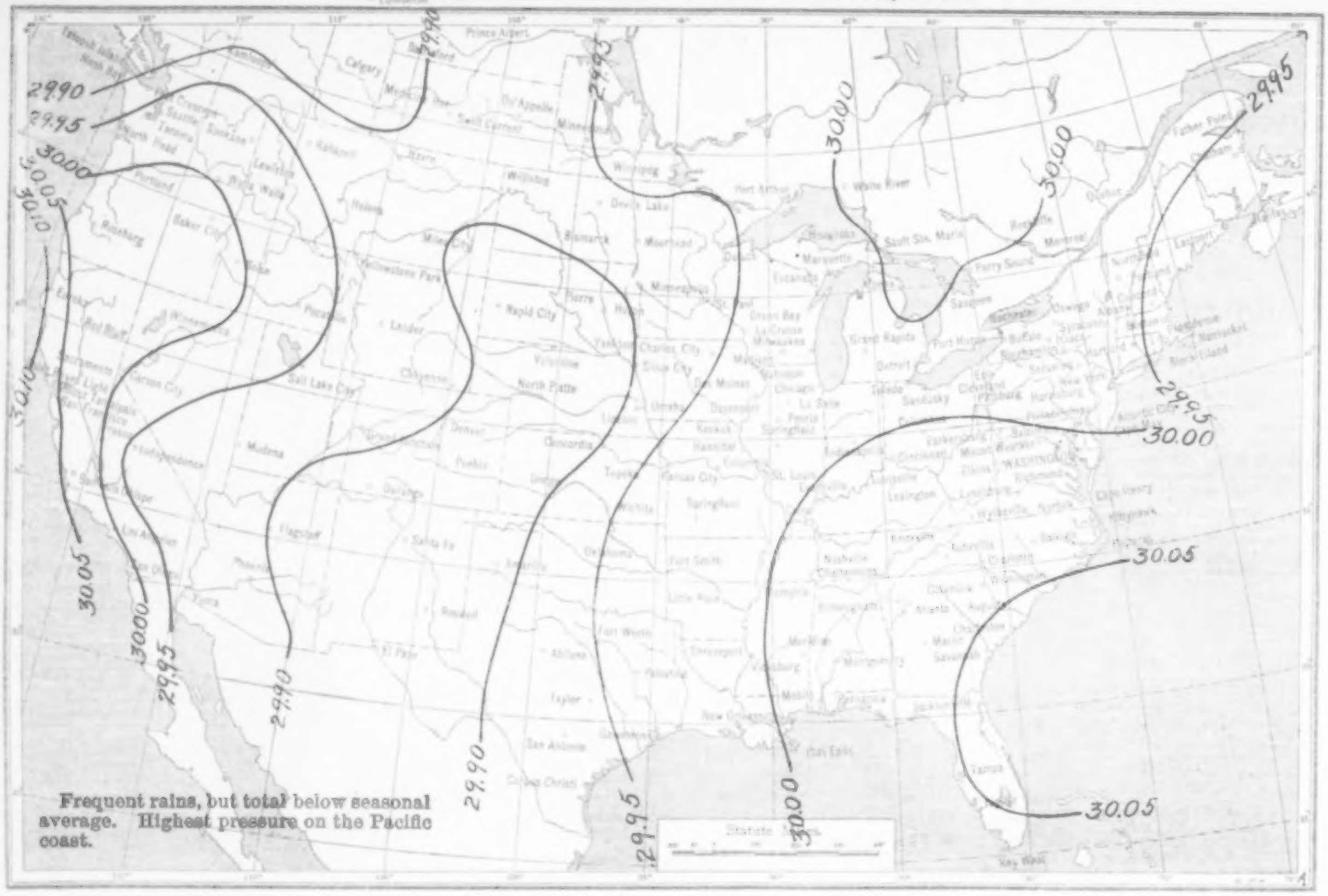
Type of dry month in wet season.

Chart X. Sea-level Pressures. February, 1902.

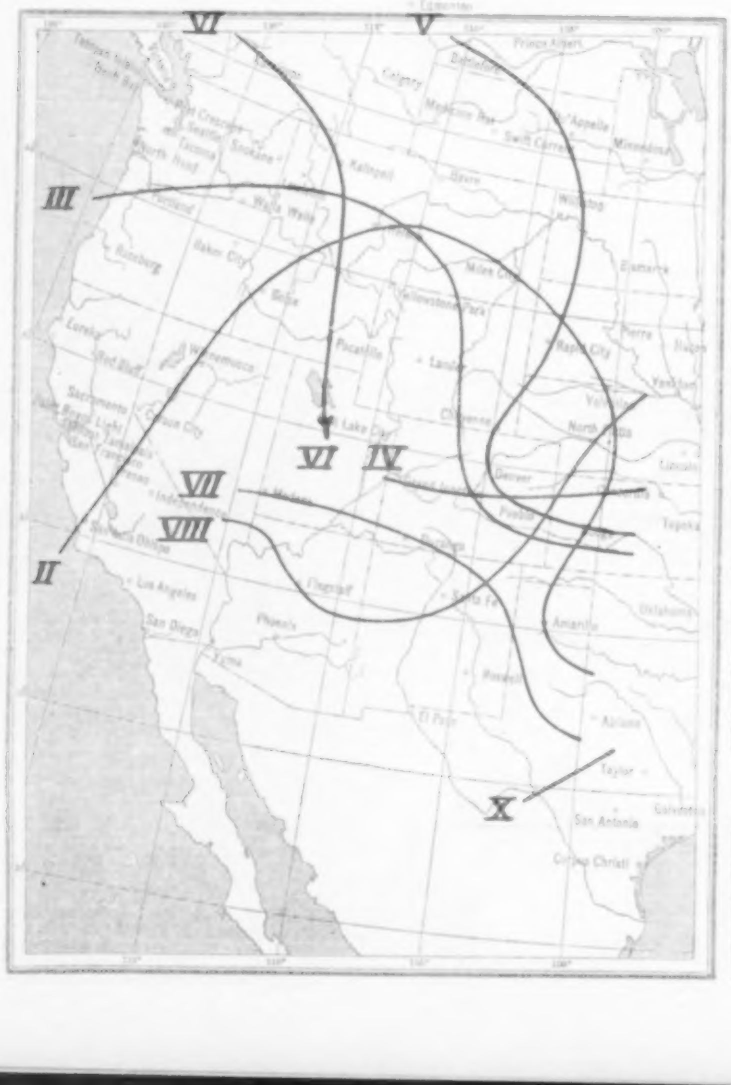


Type of unusually wet month in wet season.

Chart XI. Sea-level Pressures. March, 1902.



Paths of Centers of Low Areas.



Paths of Centers of High Areas.

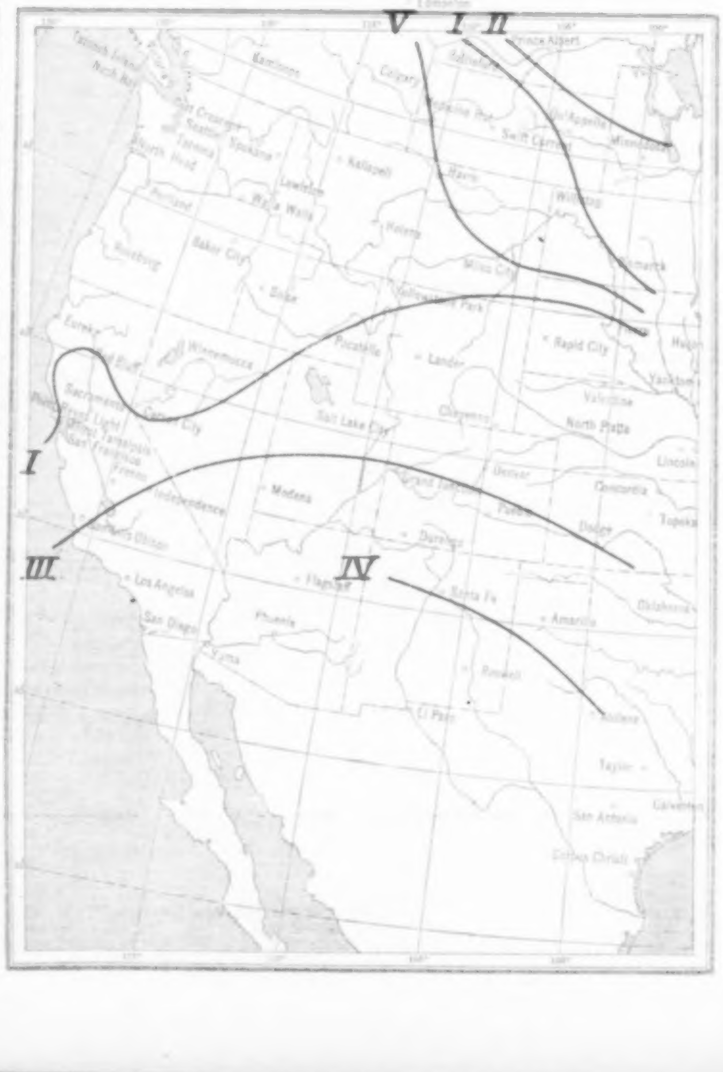
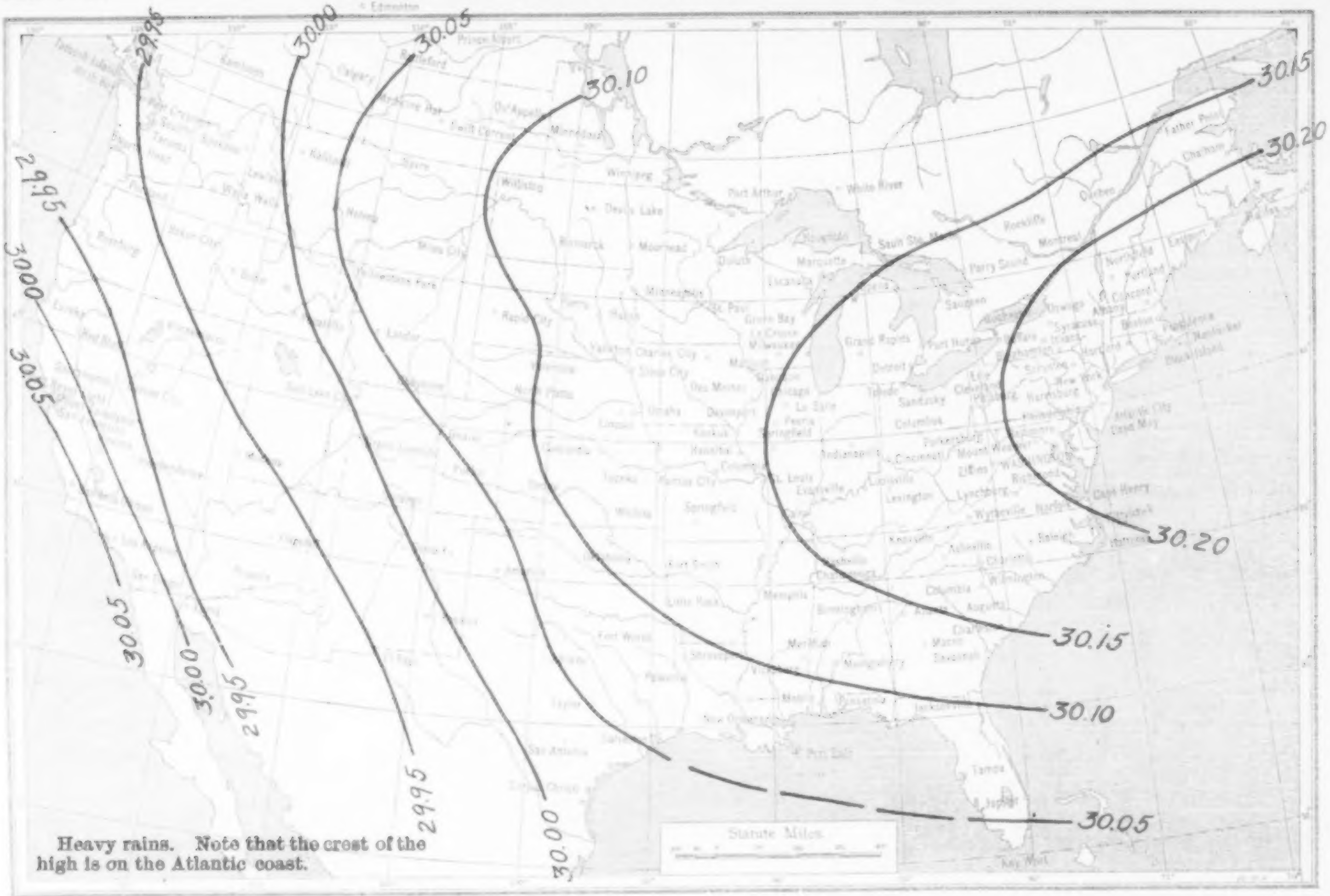


Chart XII. Sea-level Pressures. March, 1903.

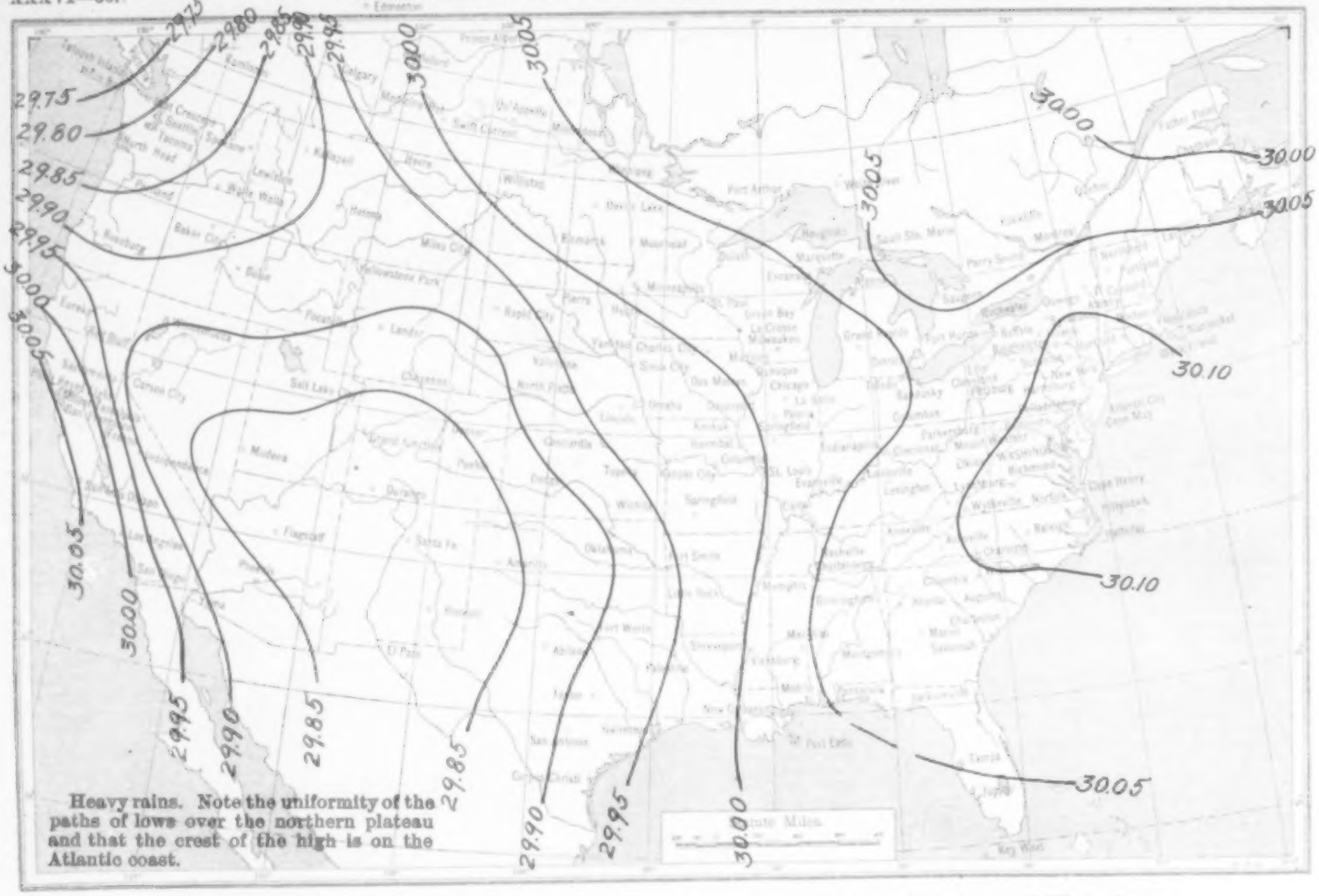


Heavy rains. Note that the crest of the high is on the Atlantic coast.

Paths of Centers of Low Areas.

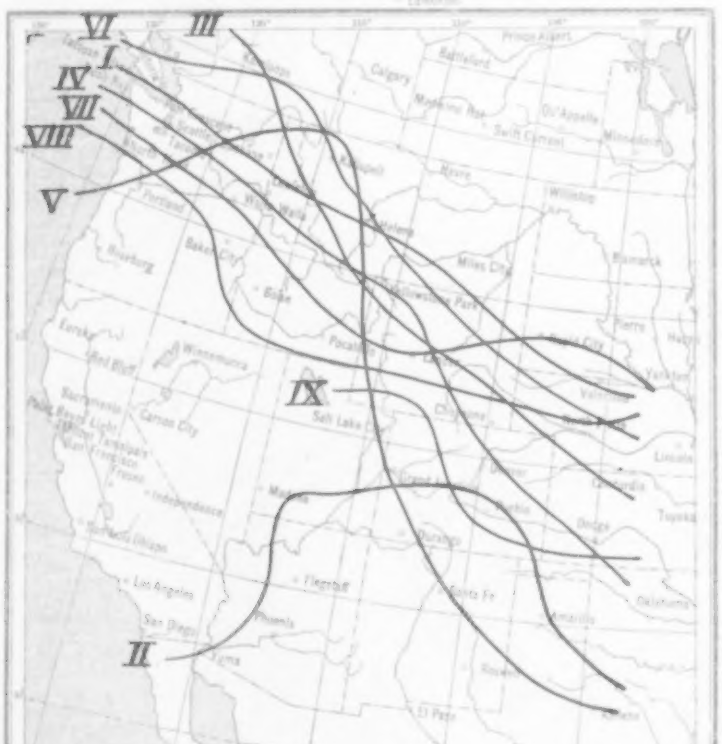
Paths of Centers of High Areas.

Chart XIII. Sea-level Pressures. March, 1904.



Heavy rains. Note the uniformity of the paths of lows over the northern plateau and that the crest of the high is on the Atlantic coast.

Paths of Centers of Low Areas.



Paths of Centers of High Areas.

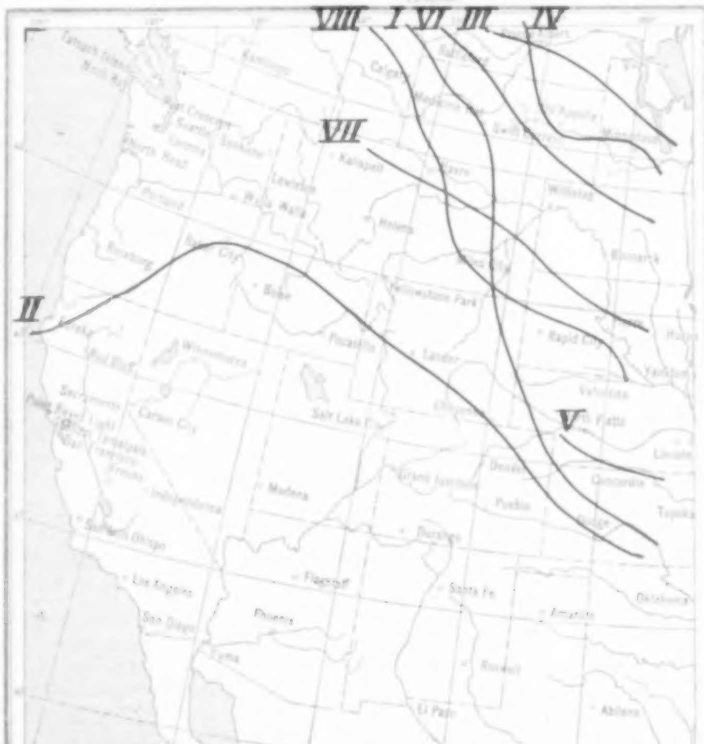
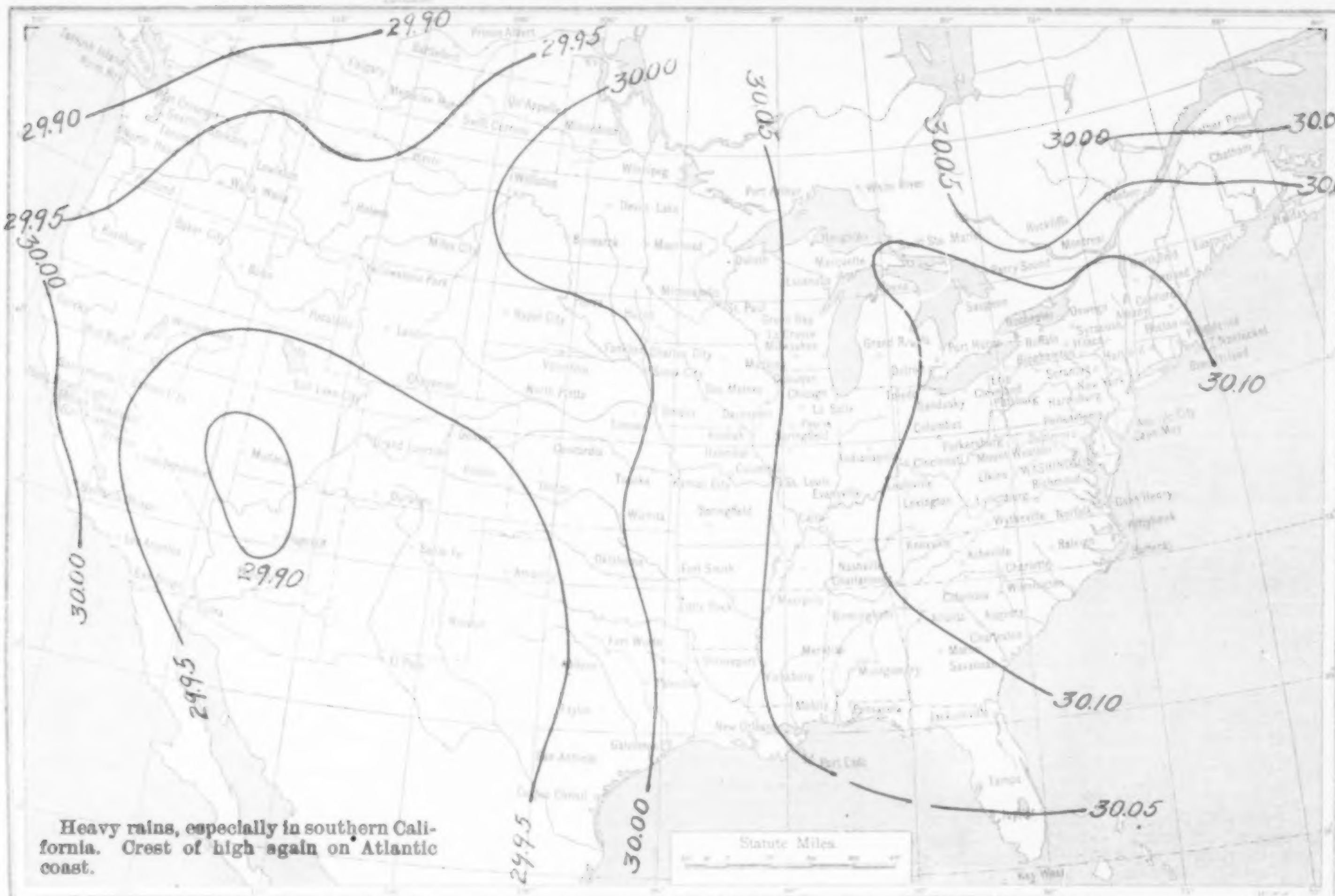
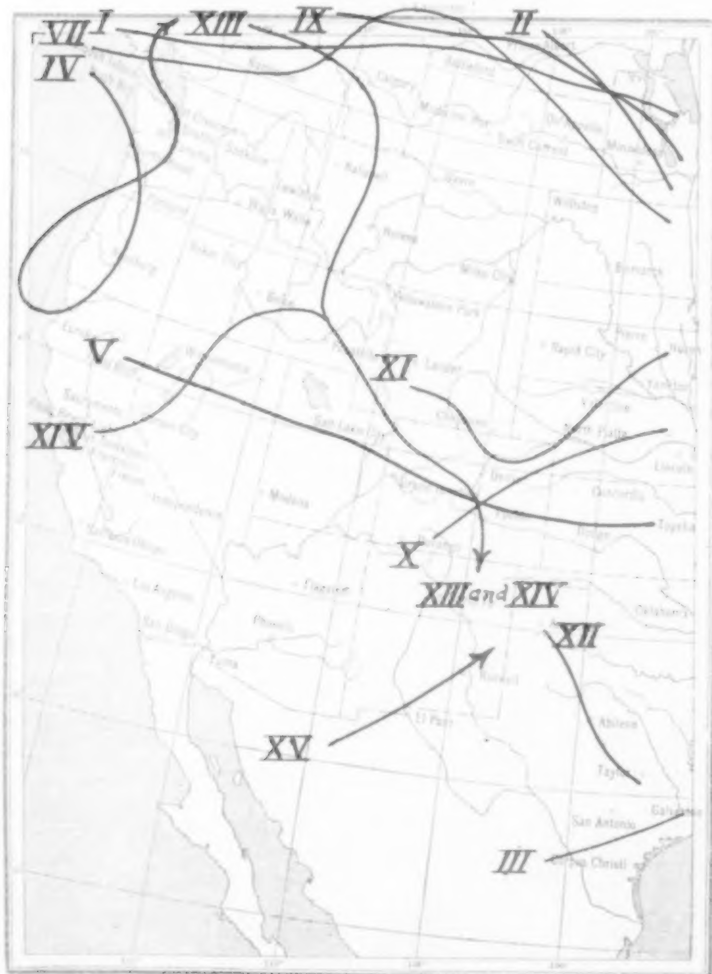


Chart XIV. Sea-level Pressures. March, 1905.



Paths of Centers of Low Areas.



Paths of Centers of High Areas.

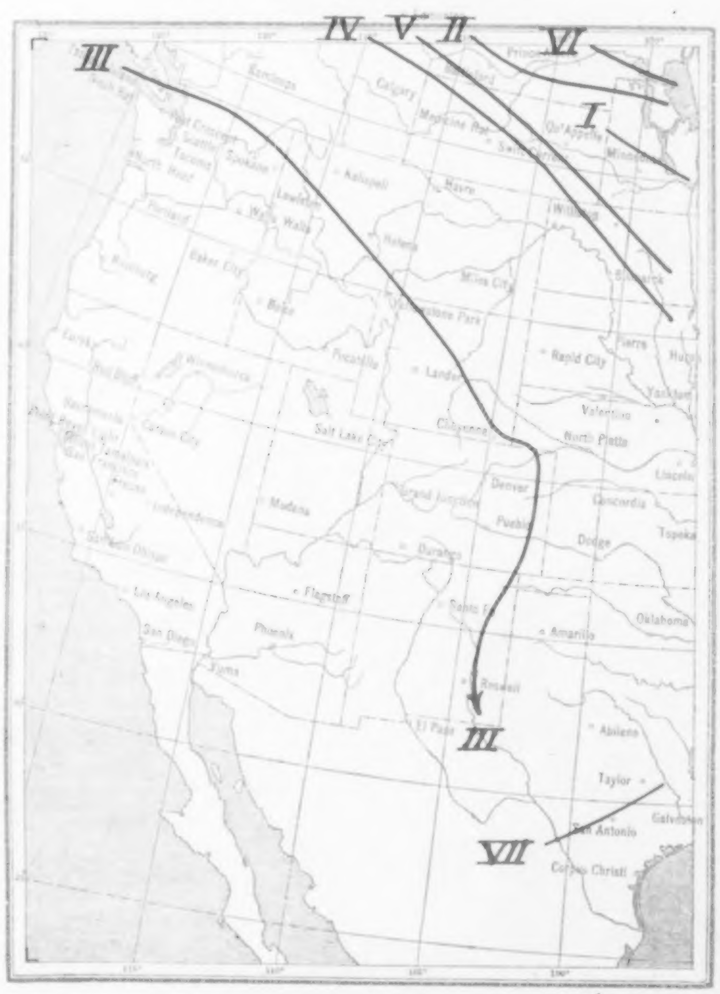
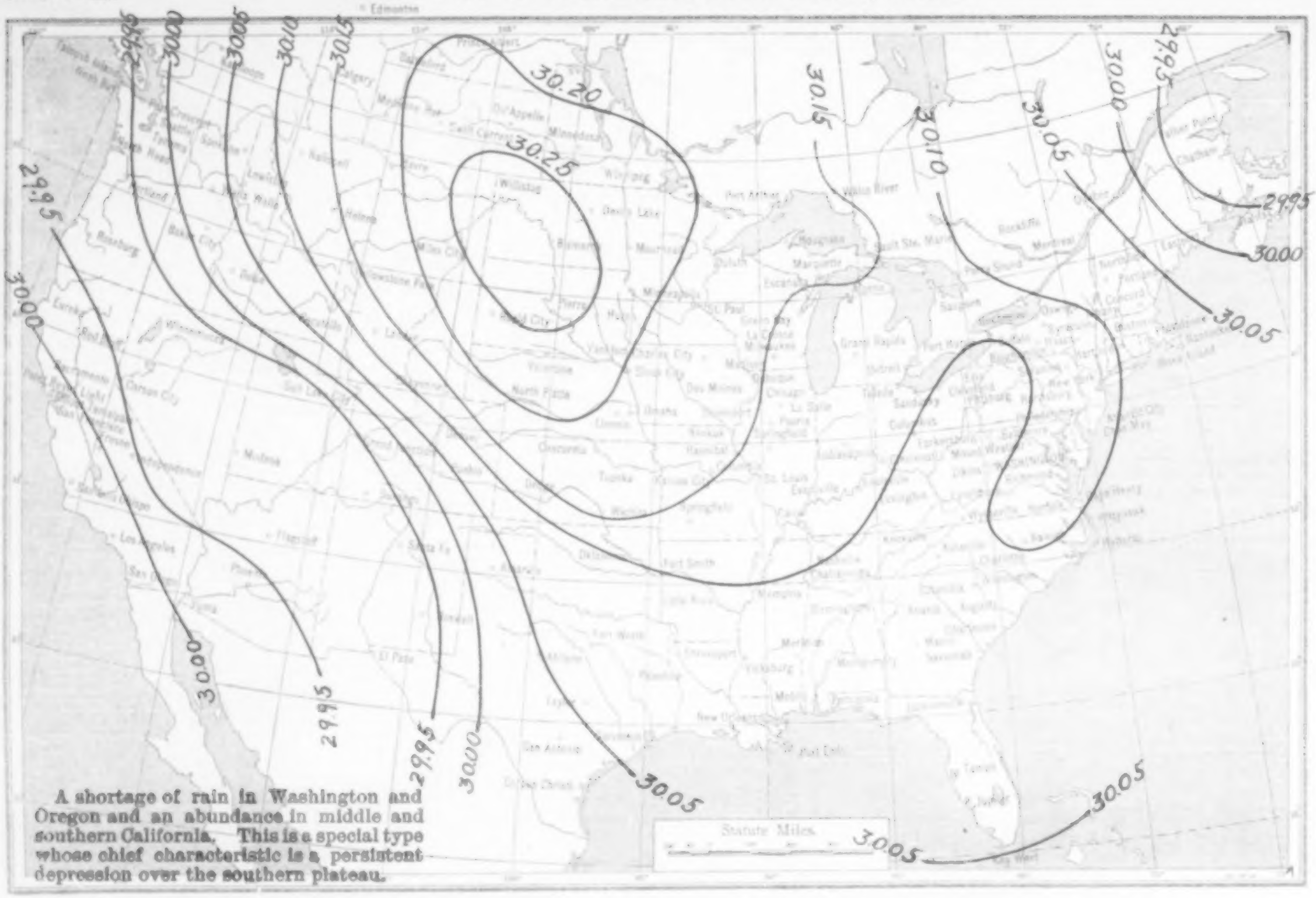
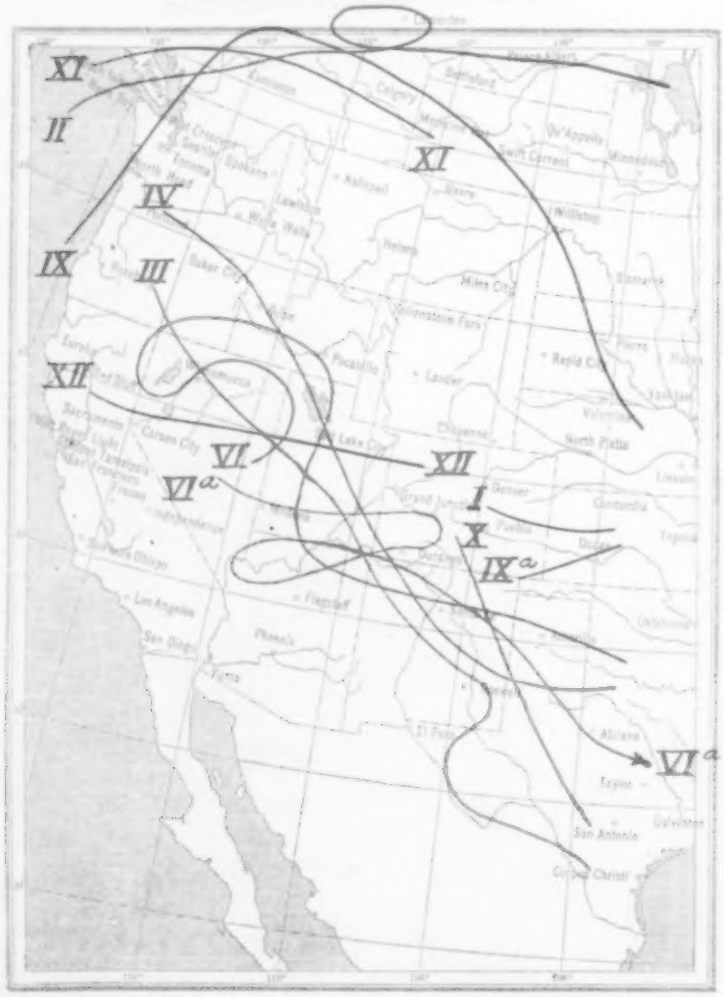


Chart XV. Sea-level Pressures. March, 1906.



A shortage of rain in Washington and Oregon and an abundance in middle and southern California. This is a special type whose chief characteristic is a persistent depression over the southern plateau.

Paths of Centers of Low Areas.



Paths of Centers of High Areas.

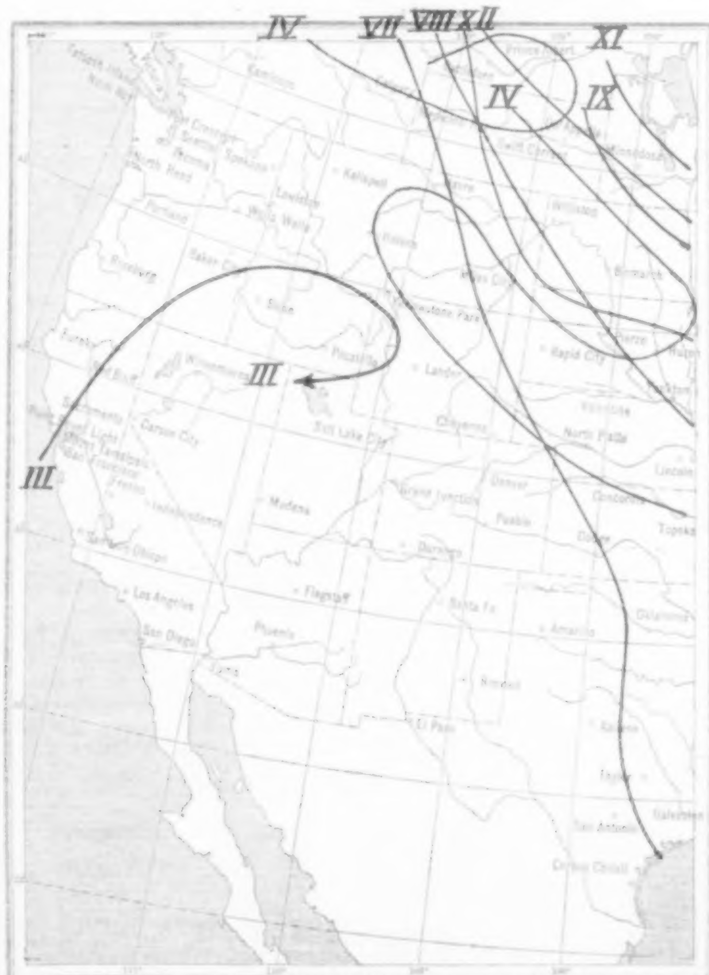
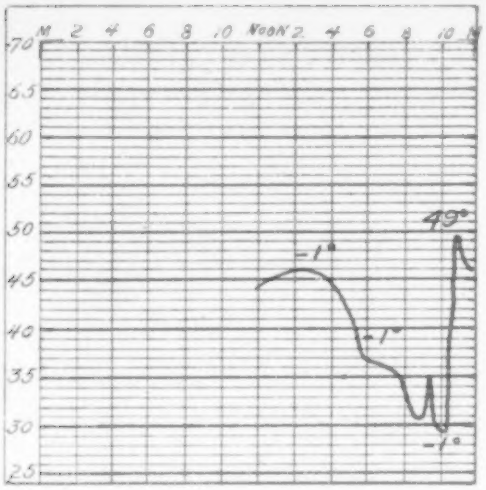
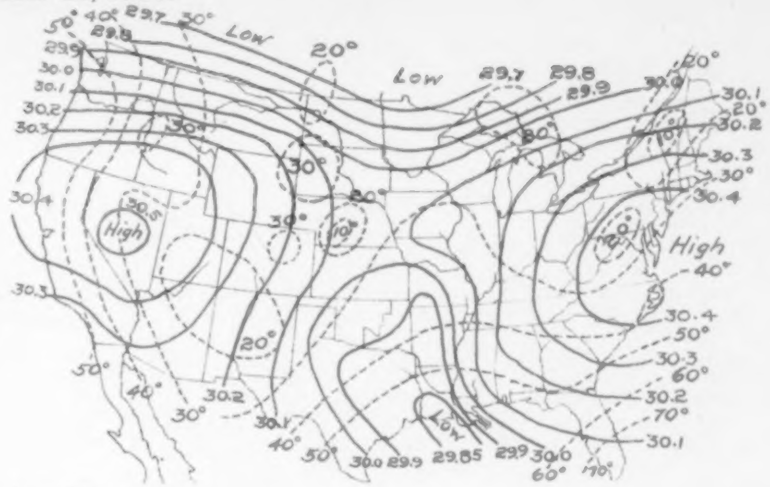
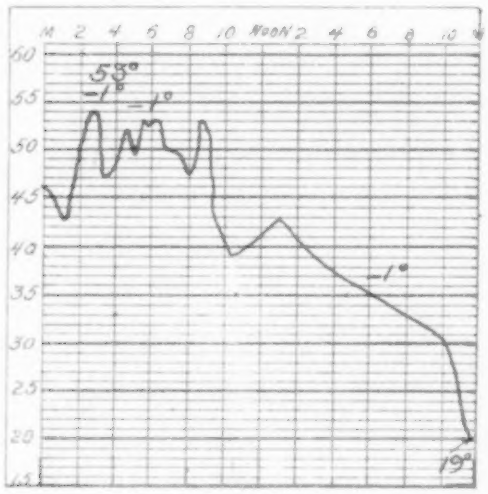


Chart XVI. Chinook Conditions at Pueblo, Colo.

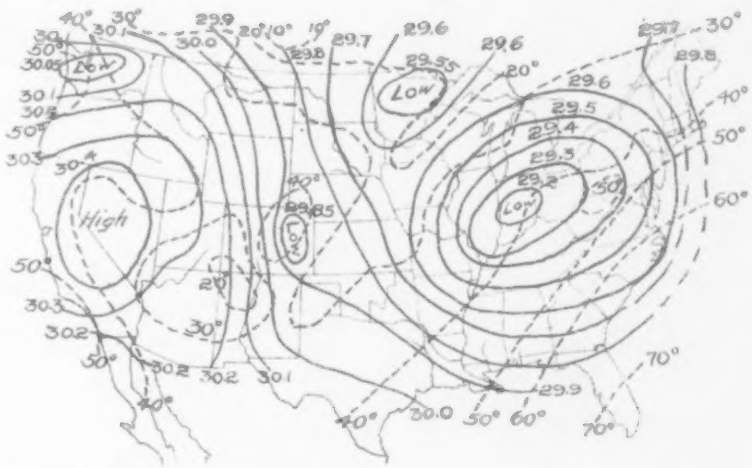


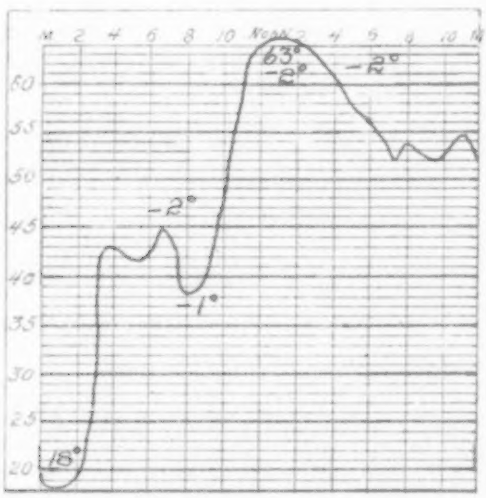
December 22, 1907.



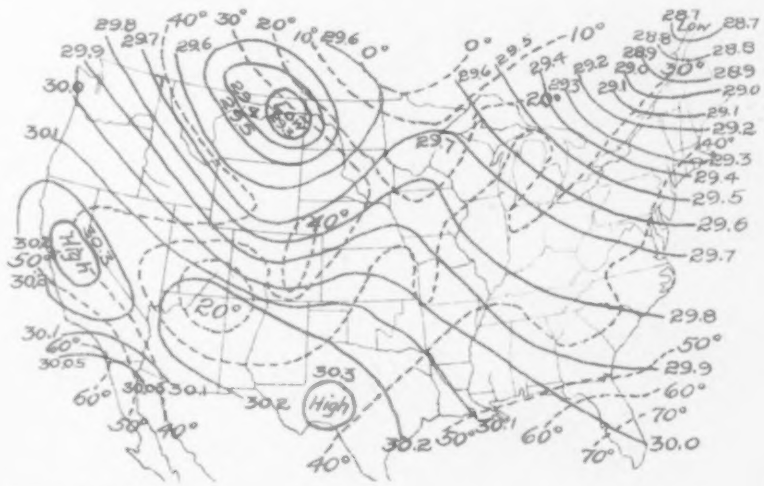


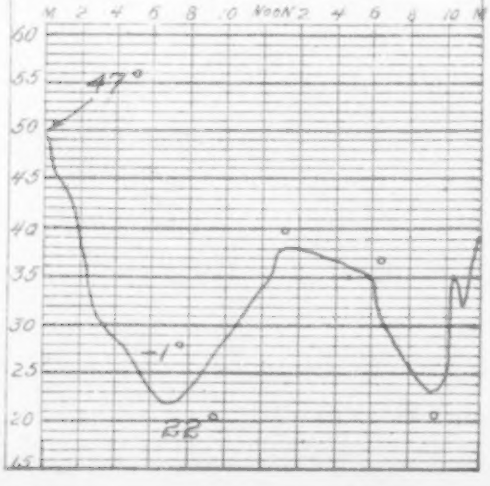
December 23, 1907.





December 24, 1907.





December 25, 1907.

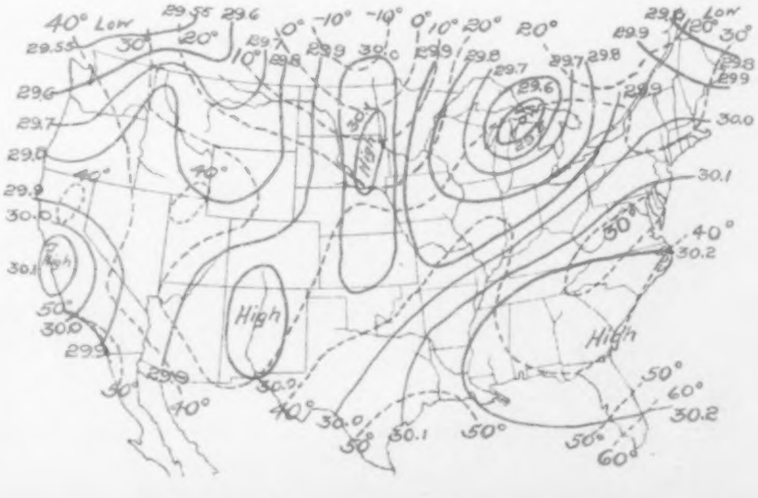
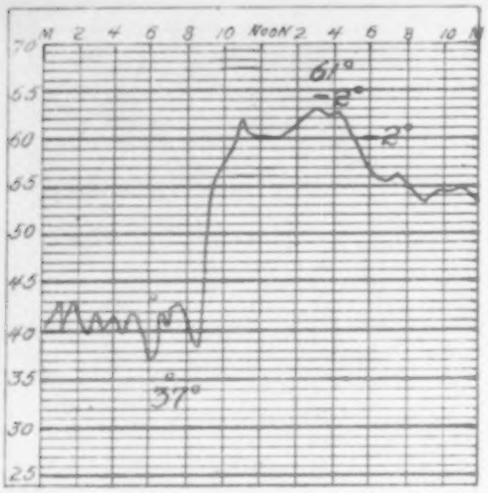
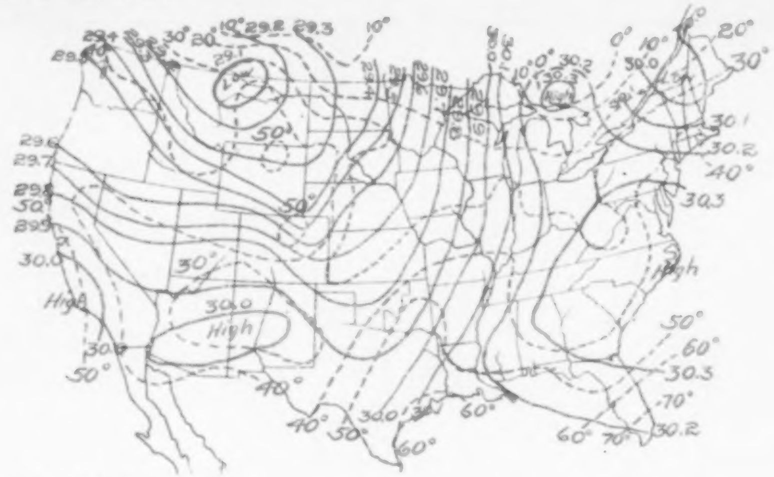


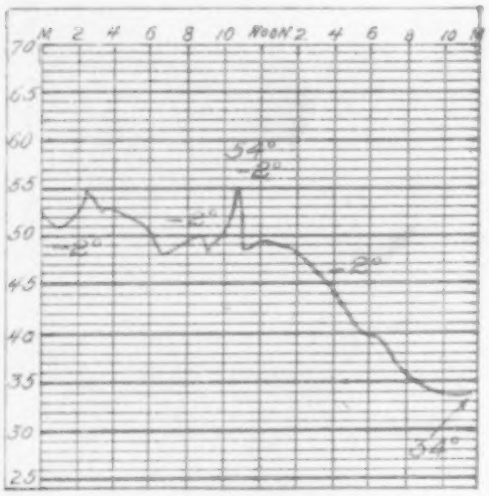
Chart XVII. Chinook Conditions at Pueblo, Colo.

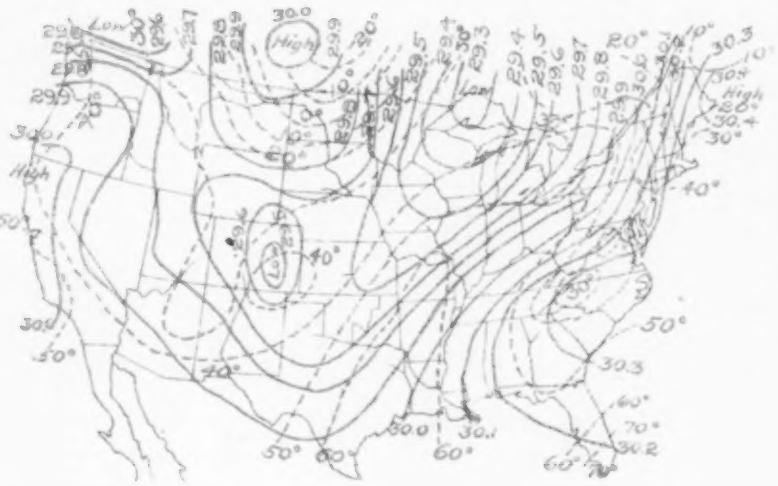
December 26, 1907.



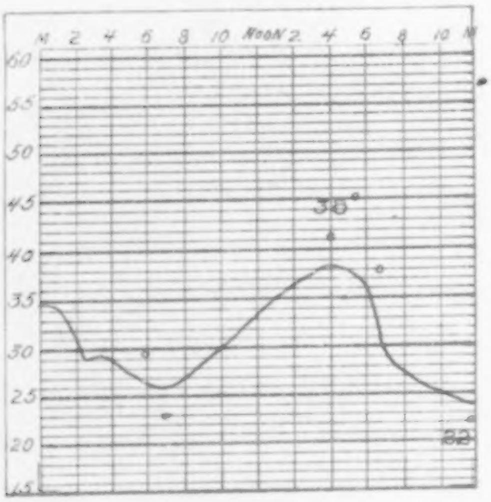


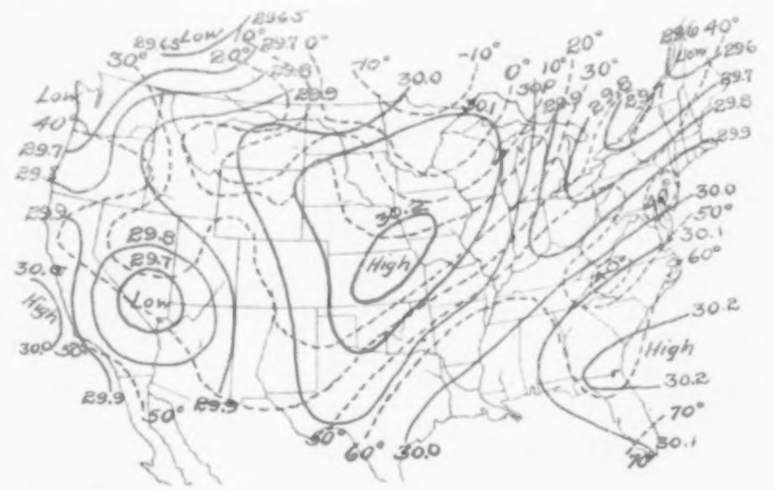
December 27, 1907.



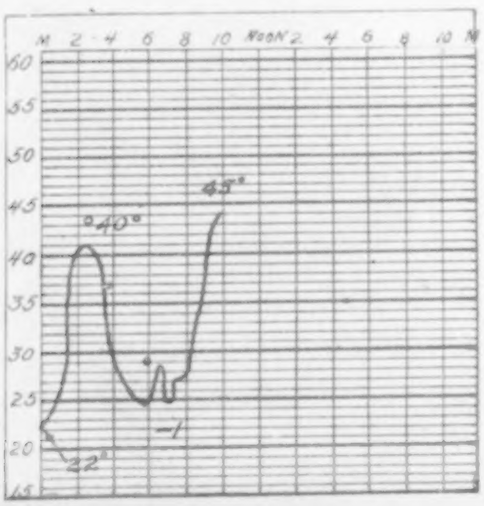


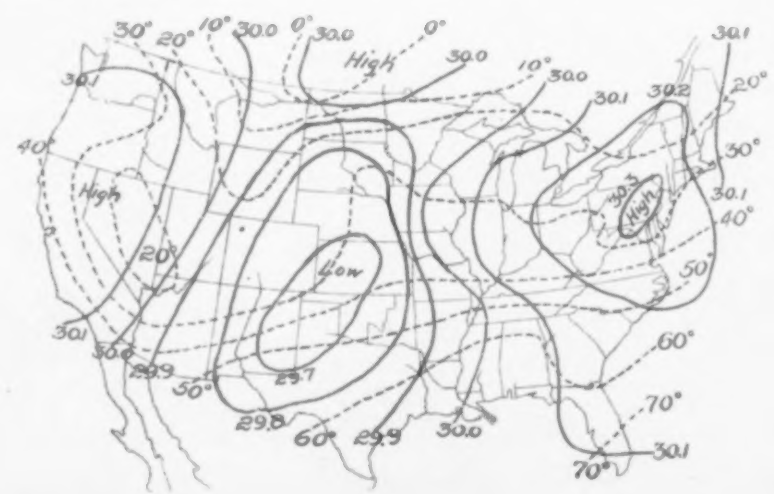
December 28, 1907.





December 29, 1907.





Honolulu, T. H., latitude 21° 19′ north, longitude 157° 30′ west; barometer above sea, 38 feet; gravity correction, —0.057 inch, applied. April, 1908.

Day.	Pressure, in inches.*		Air temperature, degrees Fahrenheit.				Moisture.				Wind, in miles per hour.				Precipitation, inches.		Clouds.					
							8 a. m.		8 p. m.		8 a. m.		8 p. m.				8 a. m.			8 p. m.		
	8 a. m.	8 p. m.	8 a. m.	8 p. m.	Maximum.	Minimum.	Wet.	Relative humidity.	Wet.	Relative humidity.	Direction.	Velocity.	Direction.	Velocity.	8 a. m.	8 p. m.	Amount.	Kind.	Direction, from.	Amount.	Kind.	Direction, from.
							°	%	°	%												
1	30.08	30.07	74.2	72.5	78	68	65.5	62	64.5	65	ne.	12	ne.	14	0.00	0.03	4 3	Ci. Cu.	nw. e.	2	N.	e.
2	30.08	30.02	72.0	72.0	77	65	64.0	65	63.0	61	e.	17	ne.	17	0.04	0.00	2 5	A.-s. Cu.	0 e.	2	Cu.	ne.
3	30.05	30.05	69.2	72.0	75	65	65.0	80	63.5	63	ne.	12	e.	18	0.05	0.06	3 6	Cu. N.	e. e.	3	S.	e.
4	30.09	30.06	72.0	70.0	76	67	65.0	69	63.0	68	ne.	14	ne.	18	T.	T.	6	Cu.	e.	7	Cu.	se.
5	30.06	30.01	73.2	72.0	77	68	64.0	60	64.5	67	ne.	13	ne.	15	0.00	0.02	9 1	Ci. Cu.	w. e.	9 1	Ci.-s. Cu.	0 ne.
6	30.02	30.01	74.0	72.5	77	69	65.0	61	65.0	67	ne.	16	ne.	10	0.00	0.00	6 1	Ci. Cu.	0 e.	4	Cu.	e.
7	30.06	30.06	71.8	72.5	78	67	66.1	74	65.5	69	e.	8	ne.	16	T.	0.18	8	Cu.	e.	8	Cu.	e.
8	30.10	30.08	72.0	71.0	78	67	65.0	69	64.5	70	ne.	8	ne.	25	T.	0.02	5 3	A.-cu. N.	w. e.	8	Cu.	ne.
9	30.11	30.09	73.4	72.0	77	69	65.0	63	65.0	69	e.	18	e.	8	0.01	0.00	8 1	Ci.-s. Cu.	se. ne.	4 4	A.-s. Cu.	nw. e.
10	30.11	30.08	74.0	71.0	77	68	66.0	65	64.0	68	e.	17	ne.	9	0.00	T.	5	Cu.	ne.	9	Cu.	ne.
11	30.06	30.02	72.4	70.5	76	68	63.1	60	66.0	79	ne.	13	ne.	6	0.01	T.	4	Cu.	0	8 1	Cu. N.	ne. ne.
12	30.05	30.03	72.0	70.5	76	66	61.0	53	62.0	62	ne.	12	ne.	18	0.04	0.00	1	Cu.	e.	Few	Cu.	ne.
13	30.05	30.02	72.2	70.5	77	68	63.3	61	64.0	70	ne.	7	e.	5	0.00	0.00	3	Cu.	e.	3 5	Ci.-s. Cu.	0 e.
14	30.06	30.07	73.0	71.0	78	69	65.0	65	66.0	77	ne.	7	s.	4	0.00	0.00	6 4	A.-s. Cu.	w. e.	4 2	Ci. Cu.	sw. se.
15	30.11	30.11	73.7	72.0	77	70	66.0	66	64.0	65	ne.	17	e.	9	0.01	0.00	8 2	Ci. Cu.	0 e.	6 4	A.-s. Cu.	nw. ne.
16	30.10	30.10	72.4	70.0	76	69	63.0	60	62.0	64	ne.	16	e.	5	0.00	0.00	9	A.-s.	w.	9 1	A.-s. Cu.	sw. ne.
17	30.09	30.08	72.0	71.0	76	68	62.0	57	62.5	62	ne.	10	e.	4	0.00	0.00	9 1	Ci.-s. Cu.	sw. e.	1 9	Cu. S.	e. e.
18	30.14	30.13	72.0	71.5	77	67	65.0	69	63.5	64	ne.	8	ne.	12	0.01	0.00	9	S.-cu.	e.	3	Cu.	ne.
19	30.15	30.13	72.7	72.5	77	70	63.0	58	64.5	65	ne.	6	e.	10	0.00	0.02	3 7	Ci.-s. S.-cu.	0 e.	7	S.	ne.
20	30.17	30.12	70.0	71.0	75	67	65.0	77	64.0	68	ne.	5	e.	12	0.05	0.00	10	N.	e.	3	Cu.	ne.
21	30.14	30.06	73.0	71.0	77	68	64.0	61	63.0	64	ne.	14	e.	10	0.03	0.00	4	Cu.	e.	7	S.	ne.
22	30.09	30.04	74.0	72.5	77	69	64.0	58	64.0	65	e.	8	ne.	10	T.	0.00	4	Cu.	se.	2	A.-s.	n.
23	30.04	30.04	73.0	71.0	76	66	66.5	71	67.0	81	0	0	sw.	9	0.00	0.00	5	Cu.	ne.	9	S.	sw.
24	30.06	30.06	71.8	72.0	78	68	66.8	77	67.0	77	w.	3	ne.	4	0.00	0.00	10	A.-s.	ne.	2	S.	ne.
25	30.04	30.03	73.0	73.0	82	67	67.0	73	67.0	73	sw.	3	se.	3	0.00	0.00	1	S.-cu.	ne.	0	0	0
26	30.02	30.01	74.0	74.0	79	68	68.0	74	67.5	71	w.	4	nw.	5	0.00	0.00	1	S.-cu.	ne.	0	0	0
27	29.99	29.99	74.7	72.2	81	67	67.0	67	66.0	72	se.	3	ne.	15	0.00	0.00	7	Ci.-s.	w.	1	A.-s.	sw.
28	30.03	30.03	75.2	72.7	80	70	67.0	65	67.0	74	sw.	3	se.	2	0.00	0.00	3	Cu.	ne.	Few	S.-cu.	ne.
29	30.05	30.04	75.3	72.0	80	70	67.0	65	67.0	77	ne.	4	ne.	9	0.00	0.00	2	Cu.	e.	6	S.	ne.
30	30.07	30.08	74.0	73.0	79	70	66.0	65	65.0	65	ne.	9	e.	12	0.02	0.00	6	Cu.	ne.	Few	S.-cu.	ne.
31																						
Mean	30.076	30.057	72.9	71.7	77.5	67.9	65.0	65.7	64.7	68.7	ne.	9.6	ne.	10.5	0.27	0.33	6.5	Cu.	e.	5.2	Cu.	ne.

Observations are made at 8 a.m. and 8 p. m., local standard time, which is that of 157° 30′ west, and is 5h and 30m slower than 75th meridian time. *Pressure values are reduced to sea level and standard gravity.

RAINFALL IN JAMAICA.

Thru the kindness of Mr. Maxwell Hall, meteorologist to the government of Jamaica and now in charge of the meteorological service of that island, we have received the following data:

Comparative table of rainfall.

[Based upon the average stations only.]

MARCH, 1908.

Divisions.	Relative area.	Number of stations.	Rainfall.	
			1908.	Average.
	Per cent.		*Inches.*	*Inches.*
Northeastern division	25	21	5.39	3.62
Northern division	22	49	1.86	2.07
West-central division	26	19	3.31	3.66
Southern division	27	30	3.14	2.15
Means	100	......	3.42	2.88

The rainfall over the Island for March, 1908, was above the average; the forecast issued early in the month was therefore verified. The maximum rainfall recorded was 19.07 inches at Shrewsbury, Portland, in the northeastern division; and the minimum rainfall recorded was 0.20 inch at Dry Harbour, in the northern division. At Gordon Town, Grand Cayman, the total rainfall for March, 1908, was 0.30 inch; it fell on the 21st.

The earthquake activity was less during March than during February, and much less than during January. The shocks had the same peculiarities as those pointed out in the last Weather Report. The two shocks at Kings Valley on the 3d were unusual and discomposing: The question arose as to what was coming next.